

**THE ROLE OF AGING AND
ONCE-THROUGH-COOLED POWER
PLANTS IN CALIFORNIA—AN UPDATE**

STAFF REPORT

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Abstract

A significant portion of California's electricity generation fleet consists of aging power plants and those relying on the use of ocean water for once-through cooling. California's dependence on these plants and related concerns about electrical system reliability and damage to marine environments have resulted in recommendations and policies to replace or retire such units. This paper updates information contained in the 2004 Energy Commission draft staff paper *Resource, Reliability and Environmental Concerns of Aging Power Plant Operations and Retirements*. It describes the plants and units central to retirement and replacement policies, their sizes and locations, their historical and current contribution to energy production in California, and their importance for the electrical system's reliability needs.

Keywords: Aging power plants, once-through cooling, local capacity requirements, local reliability, retirements, system reliability

Executive Summary

Concerns about the reliability and environmental impacts of California's electrical system have led to increased scrutiny of aging power plants and those that use ocean water for cooling. More than 16,000 MW of the state's gas-fired generation capacity is more than 35 years old. Additionally, the State Water Resources Control Board issued a draft proposal in June 2009 (revised in November, 2009) calling for the phased elimination of generating plants that use once-through cooling (OTC) by 2020 or earlier.

This report updates information and data contained in the 2004 California Energy Commission staff white paper *Resource, Reliability and Environmental Concerns of Aging Power Plant Operations and Retirements*. It describes the generating plants near the end of their service life and those additional plants that must comply with the once-through-cooling policy, their sizes and locations, their historical and current contribution to energy production, and their contribution to the reliability of California's electrical system. This report does not evaluate environmental issues, alternative scenarios, or costs associated with either the continued operation or retirement of aging and/or once-through-cooled power plants.

California's generating system includes the following capacities of aging and once-through-cooled plants:

- All aging power plant facilities, including aging OTC units (16,193 megawatts [MW]).¹
- Aging units that do not use OTC: Broadway 3; Coolwater 1-4; El Centro 3 and 4; Etiwanda 3 and 4; Grayson 3, 4, 5, and 8; Olive 1 and 2; and Pittsburg 7 (2,589 MW).
- OTC units that are not aging: the nuclear facilities at Diablo Canyon and San Onofre; portions of coastal plants that have been refurbished or are newly built; the combined-cycle units at Moss Landing, Harbor, and Haynes; and the retooled boilers at Huntington Beach 3-4² (6,795 MW).
- All OTC units, regardless of age (71, 20,400 MW).

The primary value of aging gas-fired once-through-cooled units in California is capacity, rather than generation. Aging plants that do not use OTC comprise 4 percent of the state's 2008 total capacity of 59,930 MW. Gas-fired aging plants that use OTC provide 23 percent;

¹ For this report, aging power plants are those designated as such in staff's 2004 white paper. These were limited to gas-fired resources larger than 10 MW constructed before 1979 that did not use cogeneration, in other words, did not have a companion industrial process.

² The retooled Units 3 and 4 at Huntington Beach, taken out of service in 1995, are not considered "aging" for this report.

nuclear units, which use OTC, provide 7 percent, and new gas-fired plants using OTC account for 4 percent of capacity.

While aging and new gas-fired OTC units represent 27 percent of capacity, they contribute only 7 percent of the annual energy generated. The nuclear facilities, on the other hand, contribute 11 percent of energy compared to their 7 percent share of total capacity. Dividing the contributions of gas-fired OTC units into aging and new facilities, the latter represent 4 times the capacity but produce only 30 percent more energy. The low capacity factor (11 percent) of aging gas-fired once-through-cooled units indicates that their primary value is in providing capacity. Aging and new gas-fired once-through cooled plants accounted for 19 percent of gas used for energy generation in 2008 compared to their 7 percent share of annual energy generation.

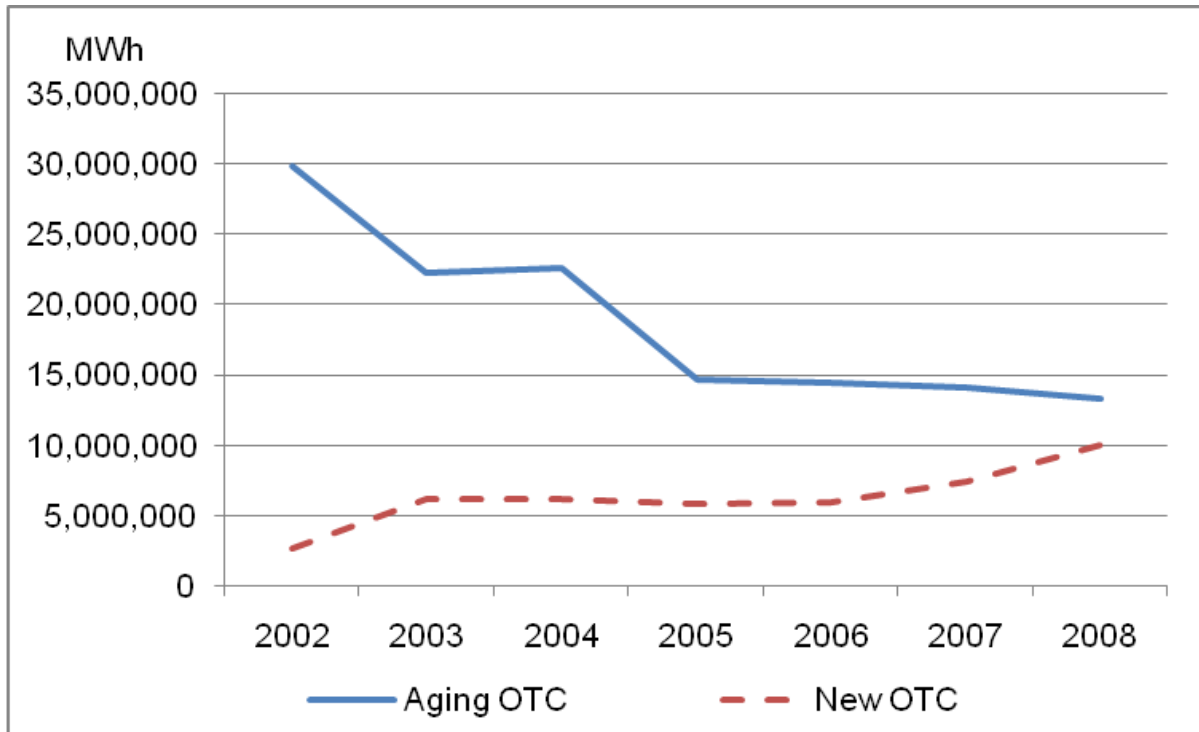
As depicted in **Figure 1**, energy generated from aging once-through-cooled plants declined from 35 million megawatt-hours (mmMWh) in 2002 to slightly more than 13 mmMWh in 2008. This decline has been somewhat offset by the generation of more than 10 mmMWh by the new once-through-cooled units, almost all of which is from the combined-cycle units at Haynes and Moss Landing. The decline in output from aging once-through-cooled facilities from 2001 to 2005 is largely a result of new gas-fired power plants coming on-line during the period; more than 14,000 megawatts (MW) of capacity licensed by the Energy Commission have begun operation since 2001. The years 2005–2008 witnessed an end to the dramatic decline in output from aging once-through-cooled facilities.

Aging once-through-cooled units generated about 13.3 mmMWh in 2008 using just over 148 trillion British thermal units (Btu) of natural gas, which equates to a heat rate of somewhat over 11,000 Btu/kilowatt-hour (kWh). In contrast, new once-through-cooled units consumed over 74 trillion Btu of natural gas to generate just over 10 mmMWh, indicating a heat rate of just less than 7,400 Btu/kWh. Thus, newer once-through-cooled units are about one-third more efficient than the older units. The relative inefficiency of older units results in their heavier use during summer months than other times of the year. However, several aging gas-fired once-through-cooled units operate throughout the year, since they are needed to meet local reliability requirements.

California's aging and OTC plants make major contributions to local reliability. In addition to that portion of the Los Angeles Basin transmission grid that is administered by Los Angeles Department of Water and Power (LADWP), most aging and OTC plants are in one of four California Independent System Operator-defined Local Reliability Areas: the Greater Bay Area, Big Creek/Ventura, the Los Angeles Basin, and San Diego.

Table 1 depicts the potential deficit of local capacity that would occur if OTC plants are eliminated. In four of the five local reliability areas discussed in the report, if the contribution of once-through-cooled plants to local capacity is not included, there would be capacity deficits in each reliability area ranging from 290 to 3,743 MW.

Figure 1: Annual Generation of Aging and New Once-Through-Cooled Gas-Fired Power Plants (2002-2008)



Source: California Energy Commission Electricity Analysis Office

Table 1: Comparison of OTC Capacity to Local Generation Share of Local Capacity Requirements (MW)

Local Reliability Area	2009 OTC Capacity/ (OTC + Aging Only Capacity)	2013 Local Capacity Requirements	2013 Total Dependable Local Generation	Surplus/ (Deficit) with OTC	Surplus/ (Deficit) without OTC
Big Creek/ Ventura	2,048 / (2,048)	3,402	5,160	1,758	(290)
Greater Bay Area	1,537 / (2,219)	5,344	6,991	1,648	111
LA Basin	7,109 / (7,850)	8,585	11,951	3,366	(3,743)
LADWP	2,636 / (2,944)	3,457	5,205	1,748	(888)
San Diego	1,647 / (1,647)	2,489	2,982	493	(1,154)

¹ Assumes the construction of 210 MW of peaking capacity in San Francisco

Source: California Independent System Operator, *2011-2013 Local Capacity Technical Analysis Report and Study Results*, Dec. 29, 2008, Table 4; LA Basin is Energy Commission staff estimate from *California ISO 2009 Net Qualifying Capacity* report, and includes the Inland Empire Energy Center; LADWP total is from Electricity Resource Planning S-1 forms (Capacity Resource Accounting Table) submitted by LADWP, Burbank, and Glendale.

Aging plants that are not once-through cooled facilities total 2,589 MW, or about 4 percent of California's total generating capacity. Merchant plants account for 80 percent of the capacity of aging-only facilities. Two large merchant plants, Etiwanda (666 MW) and Coolwater (727 MW), account for two-thirds of the merchant capacity and, in 2008, generated 97 percent of the energy from all aging merchant power plant facilities and 72 percent of the energy from all aging merchant and utility power plant facilities combined. While the combined output of utility-owned facilities remained constant over 2002–2008, that of merchant facilities substantially declined. The merchant units were load-following units that have been replaced by newer, more efficient generation. The utility-owned units, on the other hand, have long been largely used to meet summer peak loads.

The primary value of California's aging, gas-fired once-through-cooled units is capacity rather than generation, and they also make a significant contribution to local reliability. While collective output from these facilities may fluctuate in the near term because of variations such as the availability of hydroelectric generation and imports, it is likely that further reductions will require the development of new generation capacity in local reliability areas. The retirement of aging merchant facilities will frequently require replacement with a new facility at the same location or nearby unless the transmission system is expanded to allow for additional energy imports into these areas.

CHAPTER 1: Background

The portions of California's generation fleet consisting of aging power plants (APP) and those relying on the use of ocean water for once-through cooling (OTC) have come under scrutiny over the past several years as concerns mount over both the reliability of the electric system and its impact on the environment.

In 2004, California Energy Commission staff authored a white paper³ that examined the reliability impacts of the retirement of aging generating units in California and the resource and environmental effects of continued reliance on these aging units. Staff found that aging units play the following roles in ensuring reliable electric service within the state:

- They provide regional reliability by acting as a generating reserve margin for use during supply emergencies.
- They provide local reliability services in select areas through the local resource adequacy requirements imposed on load-serving entities in the California Independent System Operator's (California ISO) control area and the California ISO Reliability Must Run⁴ (RMR) process. Many of those owned by municipal utilities or irrigation districts provide cost-effective baseload, load-following, and other services, usually very near their load centers.
- They provide incremental generation to meet demand at peak times, especially on hot summer days, coming on-line at very low power levels in the morning, steadily increasing power levels during the day until the late afternoon peak, then ramping down into the evening and coming off-line as air conditioning load drops.
- They are used to alleviate transmission system congestion by providing generation at or near the load.

³ California Energy Commission, *Resource, Reliability and Environmental Concerns of Aging Power Plant Operations and Retirements*, August 13, 2004. CEC-100-04-005D.

⁴ The California ISO has historically signed one-year contracts with selected generators in specified local areas to ensure local reliability. These contracts are referred to as Reliability Must-Run; they have largely been replaced with similar, often multi-year contracts between generators and load-serving entities, which allow the California ISO to dispatch the generation resource when needed for local reliability.

Concerned about the aging of the generation fleet and its impact on system reliability following the 2004 white paper's findings, the 2005 and 2007 *Integrated Energy Policy Reports (IEPR)* called for development of a fleet replacement policy; this recommendation was addressed by the California Public Utilities Commission (CPUC) in approving the 2006 long-term procurement plans submitted by the state's major investor-owned utilities. In addition to the Energy Commission's recommendations related to aging plants, the State Water Resources Control Board (SWRCB) is moving forward with stringent limitations on OTC facilities to implement federal Clean Water Act requirements to address the impacts of using ocean water for cooling. In June 2009, the SWRCB issued a draft policy calling for the phased-in reduction of OTC impacts by 2020, if not earlier; the final policy is expected to be released for public comment during the first half of 2010. This will likely require the elimination of OTC with the possible exception of selected units at two facilities (the combined-cycle at Haynes and Units 1 and 2 at Moss Landing). Accomplishing this will require the refitting, repowering, replacement, or retirement of one-quarter of the state's generation capacity. Furthermore, it is expected that refitting of existing plants with cooling towers will frequently prove to be either infeasible, for example, given space considerations at plant sites, or uneconomic, given the alternatives of repowering or replacing the facility.

As part of the 2009 *IEPR* process, the CPUC, California ISO, and Energy Commission are cooperating with the SWRCB in the development and implementation of the latter's policy on the use of OTC by coastal power plants. The involvement of the energy agencies continues and is intended to simplify the refitting, repowering, replacement, and retirement of power plants that use OTC over the next decade while preserving the reliability of the electricity system. The compliance schedule proposed by the SWRCB incorporates input from the energy agencies regarding the amount of time that might be needed to develop the replacement infrastructure necessary to eliminate OTC.

The 2009 *IEPR* also includes discussion of greenhouse gas emissions from gas-fired power plants that are seeking power plant certifications from the Energy Commission, and the roles that these plants will play in the transition to a low-carbon electricity sector. As many of these plants will replace aging once-through-cooled facilities, information on the role and performances of such facilities informs this discussion.

This staff report provides an update on the operation and continuing role of APP and OTC plants in California's electric power system since the 2004 staff paper. The report is divided into sections as follows:

- Chapter 2 describes existing APP and OTC plants collectively and their role in meeting the state's capacity and energy needs. It also discusses changes in annual aggregate APP and OTC generation since 2002 and its distribution across the months of the year, as well as a list of the APP and OTC plants that have retired since the 2000–2001 energy crisis.
- Chapter 3 discusses the role that APP and OTC plant retirements play in securing local reliability. APP and OTC capacity as a share of total capacity and local capacity

requirements for individual California ISO-defined local reliability areas (LRAs) is presented as information on the share of APP and OTC plants that are under contract.

- Chapter 4 discusses the historical annual operation of plants aggregated by LRA and the monthly distribution of output across the months of the year for 2002 and 2008. Within the discussion of each LRA, similar information is presented for selected individual units in 2008.

CHAPTER 2: California's Aging and Once-Through-Cooled Plants

Reliability and environmental concerns affect both APP and OTC power plants. Depending on its specific characteristics (that is, whether a unit is either aging or OTC or both), a power plant will potentially be subject to different sets of regulatory concerns and timetables. An aging plant that does not use OTC, for example, would be a candidate for retirement as part of a fleet replacement policy but would obviously be unaffected by any SWRCB policies. Other plants, such as a newly repowered coastal facility, do not pose reliability concerns related to aging but would have to comply with any promulgated OTC regulations. **Figure 2** shows the following APP and OTC categories:

- All APP facilities, including aging OTC units (16,193 MW).⁵
- Aging units that do not use OTC: Broadway 3; Coolwater 1-4; El Centro 3 and 4; Etiwanda 3 and 4; Grayson 3, 4, 5, and 8; Olive 1 and 2; and Pittsburg 7 (2,589 MW).
- OTC units that are not aging: the nuclear facilities at Diablo Canyon and San Onofre; portions of coastal plants that have been refurbished or are newly built; the combined-cycle units at Moss Landing, Harbor, and Haynes; and the retooled boilers at Huntington Beach 3-4⁶ (6,795 MW).
- All OTC units, regardless of age (20,400 MW).

Aging combustion turbine generators are not considered in this paper. These types of units are not cooled with ocean water, so are not subject to SWRCB policies. They operate at low capacity factors, which, despite high heat rates, produce relatively few emissions and thus have limited impact on the environment. Additionally, they have very low fixed and non-fuel variable costs, so are generally not prohibitively expensive to operate at low usage rates. Therefore, it is unlikely that owners will retire these types of units in sufficient numbers adversely affect system reliability.

The aging units discussed in this paper are boilers originally designed and operated to provide baseload energy, that is, to operate as much as possible annually. As these facilities have gotten older, newer, more efficient plants have come on-line, making older plants comparatively more expensive to operate as baseload units. Thus, aging plants have taken on new system reliability roles during periods of high peak loads, such as on hot summer

⁵ For this report, APPs are those designated as such in staff's 2004 white paper. These were limited to gas-fired resources larger than 10 MW constructed before 1979 that did not use cogeneration, in other words, did not use a companion industrial process.

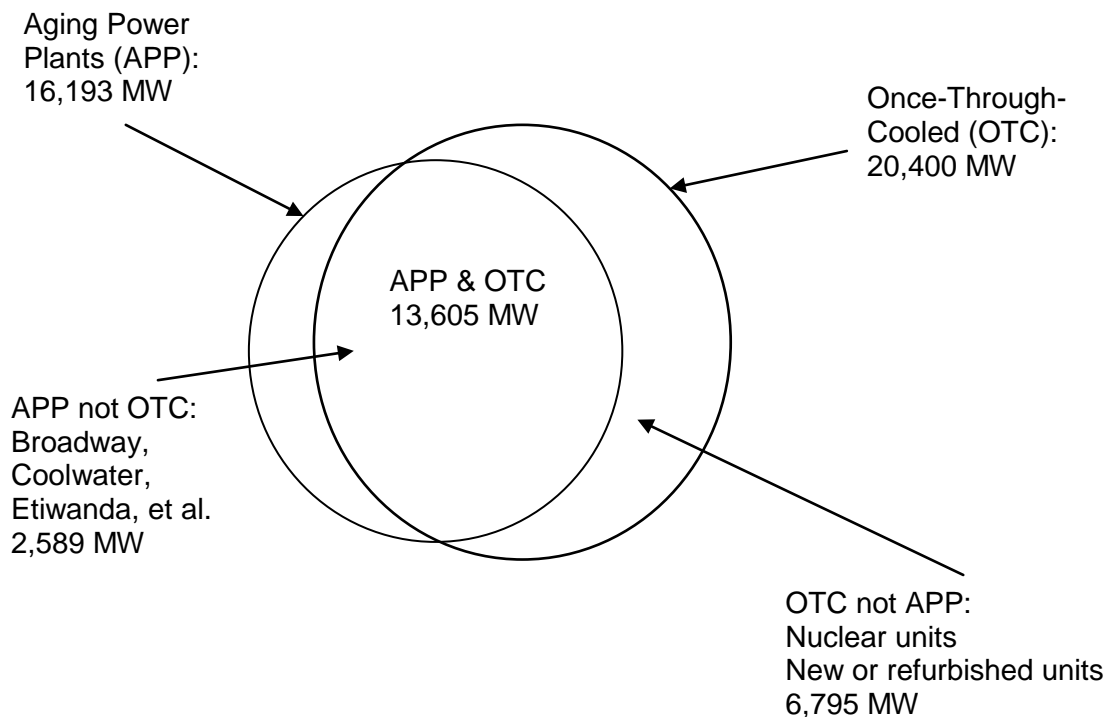
⁶ The retooled Units 3 and 4 at Huntington Beach, taken out of service in 1995, are not considered "aging" for this report.

days. Although less efficient than modern combined-cycle facilities, their efficiency remains nearly constant over a wide range of power levels, enabling them to ramp up and down (increase and decrease the level of power generation) as demand rises and falls over the course of the day.

The state's two nuclear plants are not considered in the aging plant category but do use ocean water for OTC. As almost 4,500 MW of efficient baseload generation in the Los Angeles Basin, these play a vital role in meeting California's energy and capacity needs. This report, however, focuses solely on aging fossil units and those that use OTC.

Figure 3 shows the percentages in relation to the 2008 total statewide capacity of 59,630 MW. Aging and new gas-fired OTC is a relatively large component of total capacity at 27 percent, while nuclear is only 7 percent of the state's total capacity. The largest portion of statewide capacity is composed of other types of facilities, such as hydroelectric and new facilities that do not use ocean water for cooling.

Figure 2: The 2009 Universe of Aging and Once-Through-Cooled Power Plants (22,989 MW Total)

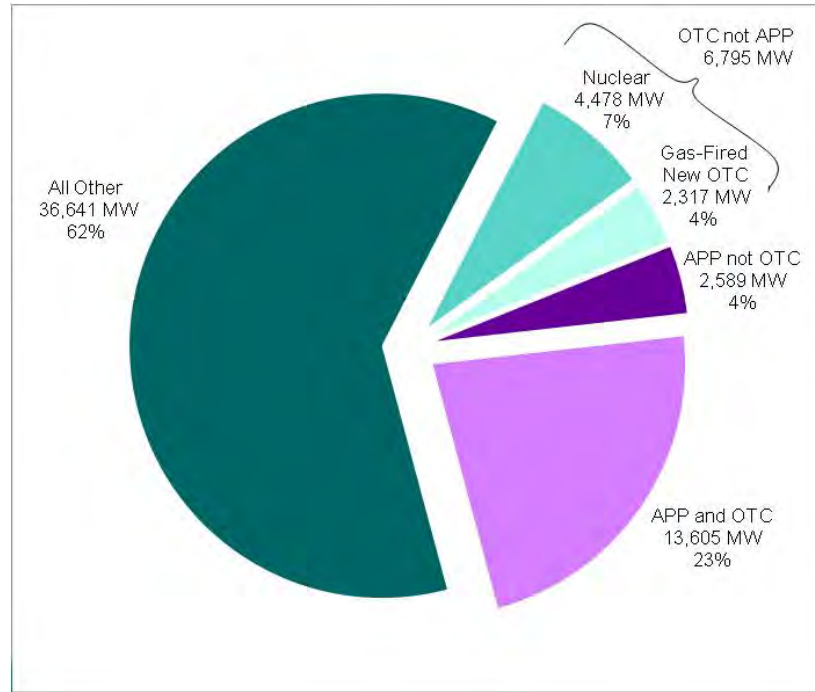


Source: California Energy Commission Electricity Analysis Office

Figure 4 presents the percentages that nuclear, natural gas, OTC, and aging plants contributed to statewide energy generation in 2008 by the same categories shown in **Figure 33**. Immediately evident is that while aging and new gas-fired OTC units represent 27 percent of capacity, they contribute only 7 percent of the annual energy generated. The nuclear facilities, on the other hand, contribute 11 percent of energy compared to their

7 percent share of total capacity. Dividing the contributions of gas-fired OTC units into aging and new components, the latter represent four times the capacity but produce only 30 percent more energy. The low capacity factor (11 percent) of aging gas-fired OTC units indicates that their primary value is in providing peak capacity. Since such units are expensive to operate, they do so primarily when the value of the energy generated is highest, which is during peak demand periods.

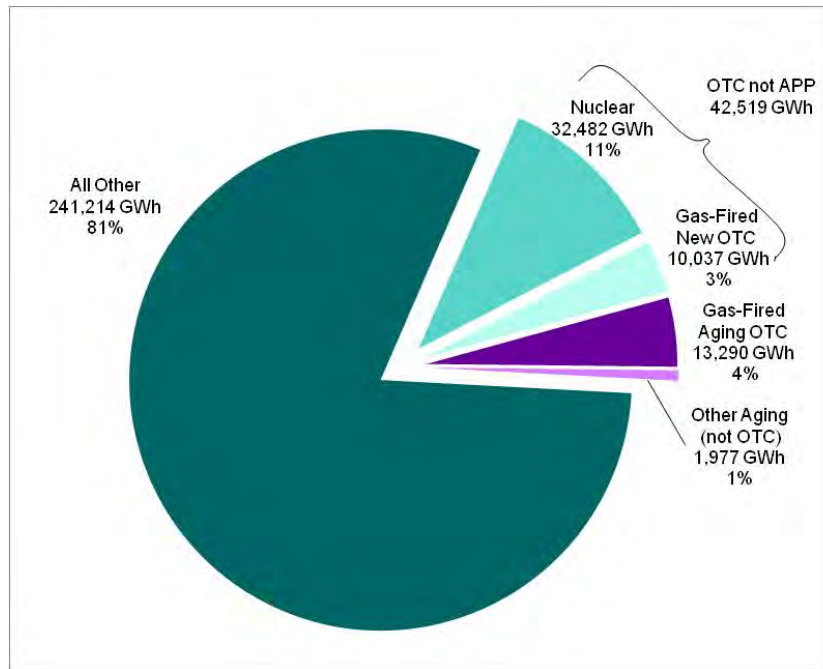
Figure 3: Nuclear, Natural Gas-Fired Once-Through-Cooled and Aging Power Plants, Percentage of Statewide Capacity, 2008



Source: Energy Commission Electricity Analysis Office

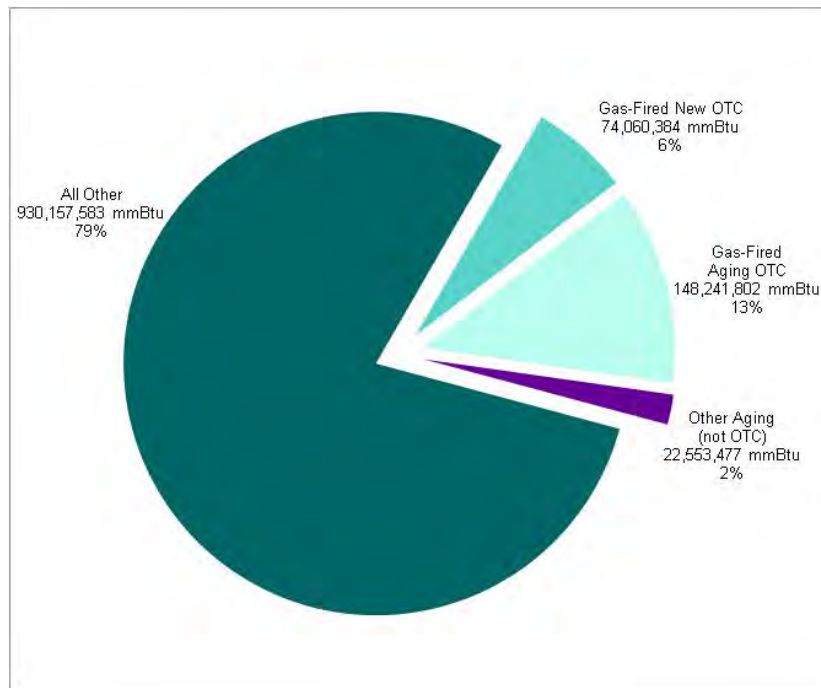
Figure 5 shows the relative amount of natural gas used by the natural gas-fired OTC and APP categories. Aging and new gas-fired OTC plants account for 19 percent of gas used for energy generation in 2008 compared to their 7 percent share of annual energy generation. As shown in the previous figures illustrating shares of capacity and energy generation, aging plants that are not OTC are a small component of gas used in the generation sector.

Figure 4: Nuclear, Natural Gas-Fired Once-Through-Cooled and Aging Plants, Percentage of Statewide Energy Generation (2008)



Source: Energy Commission Electricity Analysis Office

Figure 5: Natural Gas-Fired Once-Through-Cooled and Aging Percentage of Electricity Sector Gas Use (2008)



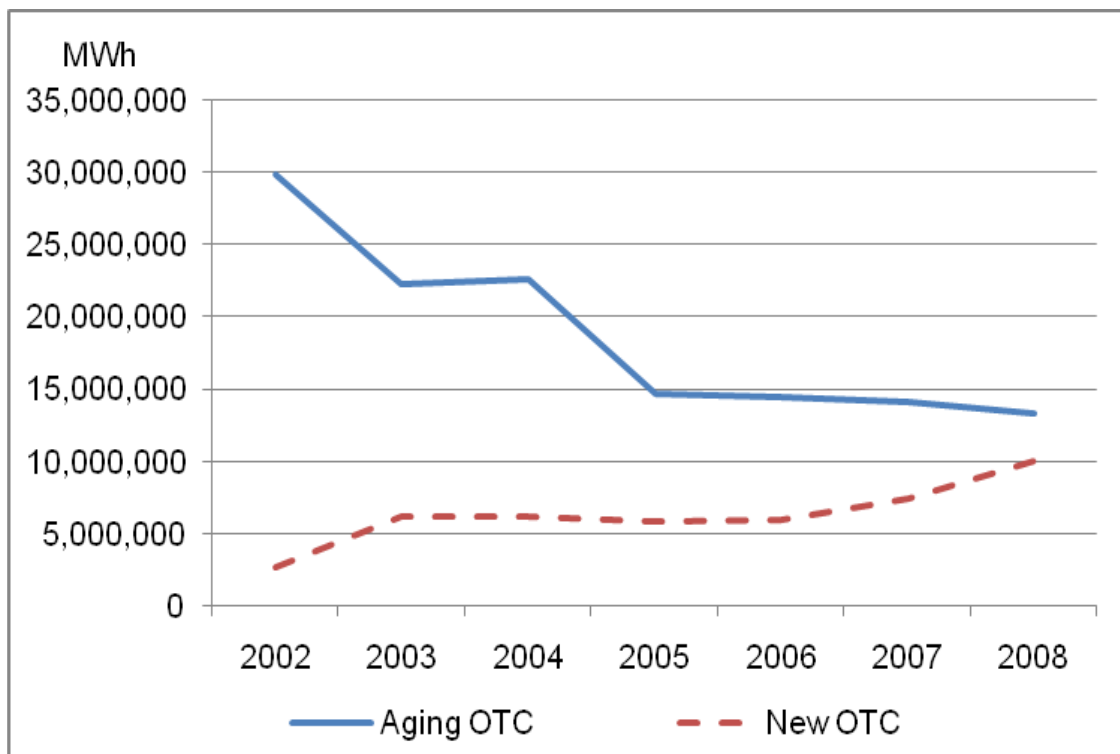
Source: Energy Commission Electricity Analysis Office

The Performance of Once-Through-Cooled Power Plants 2002–2008

OTC is used at some or all of the units at 19 generation facilities in California. These units total 20,400 MW of capacity, roughly 35 percent of the capacity serving the state's energy needs. They include the state's four nuclear units (two each at Diablo Canyon and San Onofre, totaling 4,478 MW) and newer gas-fired facilities: the combined-cycle units at Los Angeles Department of Water and Power's (LADWP's) Haynes and Harbor facilities (560 MW and 227 MW, respectively) and two of the units at the Moss Landing merchant facility (1,080 MW). Of the 17 gas-fired facilities that use OTC, aging units (those more than 30 years old) can be found at 16 of them, constituting more than 13,600 MW of capacity.

Aging OTC capacity consists largely of steam turbines built to meet baseload energy needs from 1950-1978. **Figure 6** depicts the declining energy generated by aging OTC plants, dropping from 30 million megawatt hours (mmMWh) in 2002 to slightly more than 13 mmMWh in 2008. The generation of more than 10 mmMWh by the new OTC units, mainly from the combined-cycle units at Haynes and Moss Landing, offsets this decline somewhat.

Figure 6: Annual Generation of Aging and New Once-Through-Cooled Gas-Fired Power Plants (2002-2008)



Source: Energy Commission Electricity Analysis Office

The decline in output from aging OTC facilities from 2002 to 2005 is largely a result of new gas-fired power plants coming on-line during the period. Since 2001, more than 14,000 MW

of new gas-fired capacity licensed by the Energy Commission began operation.⁷ While some aging OTC capacity retired during 2001–2009, most of this capacity was seldom dispatched; its retirement had little effect on collective generation by OTC facilities. The reduction in output illustrated in **Figure 6** largely results from reduced generation by power plants that continue to operate.

The dramatic decline in output from aging OTC facilities ended in 2005–2008. While aggregate output from these facilities may fluctuate in the near term from variations such as the availability of hydroelectric generation and imports, it is likely that further reductions will require new generation capacity in LRAs, which would supplant individual aging OTC facilities as providers of local reliability services; this is discussed in greater detail in another section of this report. Any new generation means many aging merchant facilities would retire, if only to be replaced by a new facility at the same or nearby location. In sum, further reductions in the aggregate output from aging OTC facilities will be from retirements, with possible on-site replacement.

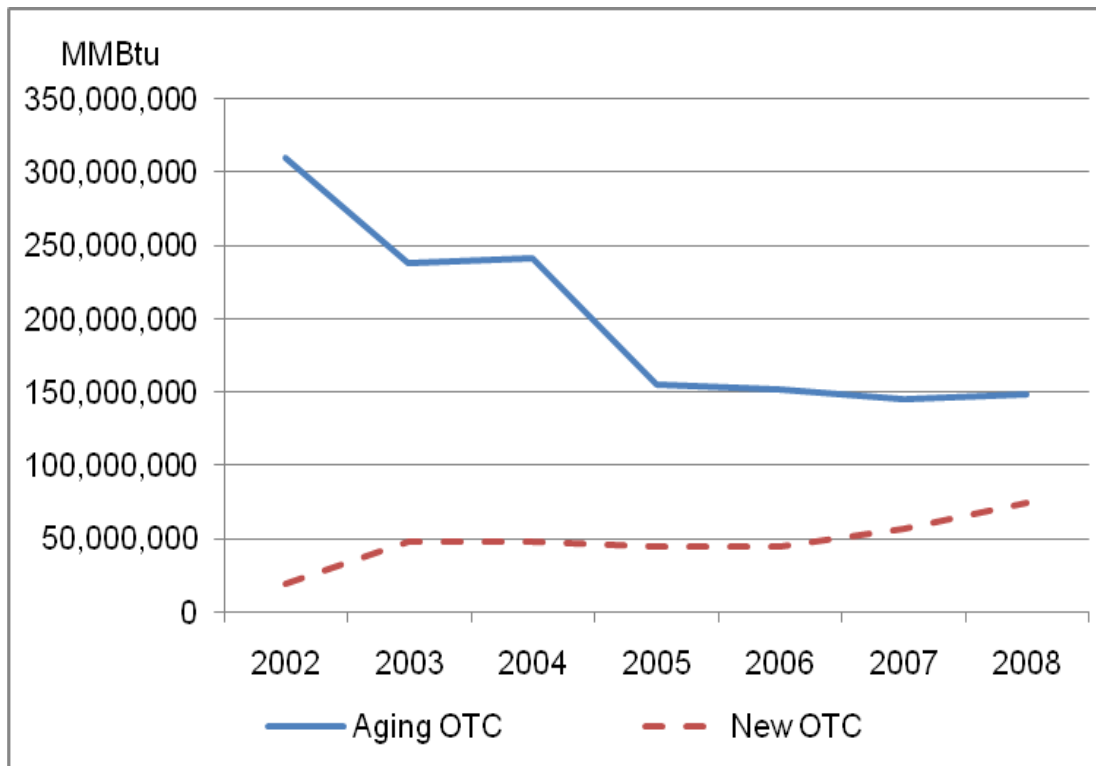
Figure 7 shows the annual fuel use for aging and new OTC plants. While it is apparent that annual fuel use closely tracks generation, the data from **Figure 6** and **Figure 7** can be used to examine the relative efficiencies of old and new OTC units. In 2008, aging OTC units generated about 13.3 mmMWh using just over 148 trillion British thermal units (Btu) of natural gas, which equates to a heat rate⁸ somewhat over 11,000 Btu/kilowatt hours (kWh). In contrast, new OTC units consumed more than 74 trillion Btu of natural gas to generate just over 10 mmMWh, indicating a heat rate just under 7,400 Btu/kWh. Thus, newer OTC units are about one-third more efficient than the older units.

The 2008 annual average heat rates for individual gas-fired OTC units can be found in **Table B-1**.

⁷ See http://www.energy.ca.gov/sitingcases/all_projects.html for a list of the projects.

⁸ Heat rate is a measure of power plant efficiency expressed in terms of Btu/kWh. A low heat rate indicates an efficient unit that uses relatively less fuel to generate a given amount of electricity.

Figure 7: Annual Fuel Use of Aging and New Gas-Fired OTC Plants (2002-2008)

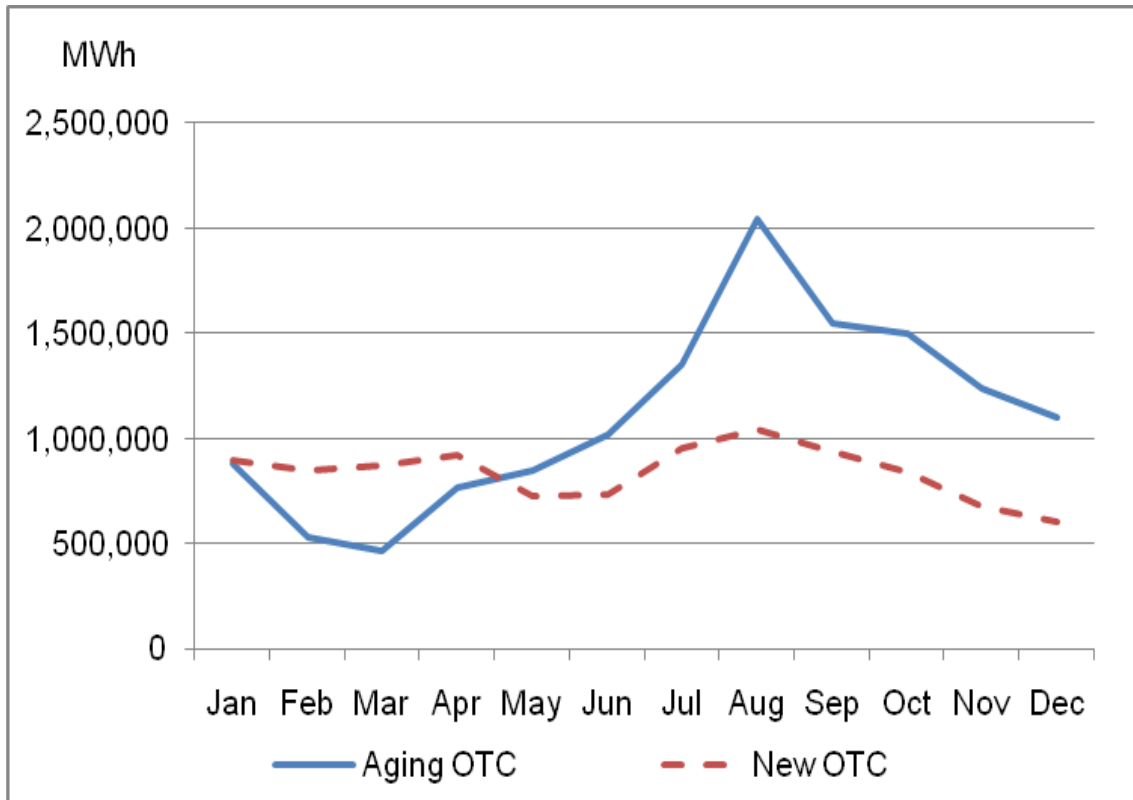


Source: Energy Commission Electricity Analysis Office

Figure 8 illustrates that gas-fired aging OTC facilities are more heavily used during the summer months than other times during the year. This follows in part from their relative inefficiency compared to other thermal resources, such as nuclear facilities and newer gas-fired generation. The latter, with lower variable costs, are operated around the clock and around the year to meet the component of demand that is constant. Older, gas-fired merchant OTC plants are predominantly used to meet higher loads during the summer, with more efficient ones being used more often (for example, in the late spring and fall), and the least efficient plants being used only as a last resort (on the hottest days of the summer).

Figure 8 also shows that gas-fired aging OTC plants provide energy during non-summer months, albeit at reduced levels compared to the summer. In fact, several aging gas-fired OTC plants are dispatched throughout the year to meet local reliability requirements; 16 of the 19 OTC plants are in California ISO-designated LRAs or the transmission-constrained LADWP control area. This is discussed in detail in a later section of this document.

Figure 8: Monthly Generation of Aging and New Gas-Fired OTC Plants (2008)



Source: Energy Commission Electricity Analysis Office

Aging and OTC Plant Retirements, 2001–2008

Table 2 shows the aging and OTC units that have retired over the past eight years, resulting in 2,740 MW of cumulative statewide capacity reduction since 2001. The energy generated from these units in 2002 was approximately 1.4 mmMWh.

Table 2: Major Aging and OTC Plant Retirements¹

Plant Name/Unit Name	Capacity (MW)	Retired Year	2002 Generation (MWh)
Mountainview 1 and 2 ²	130	2001	11,867 ³
Long Beach 8 and 9	148	2001	159,803 ³
El Segundo 1 and 2	312	2002	70,828
Etiwanda 1 and 2	246	2002	110,065
Valley 3	163	2002	21,658
Haynes 4	230	2003	106,378
Morro Bay 1 and 2	338	2003	102,960
Valley 4	163	2003	28,002
Haynes 3	230	2004	205,790
Pittsburg 1-4	624	2004	92,041
Hunters Point 4	156	2006	477,150
Total	2,740	-	1,386,542

¹ Does not include facilities that do not use OTC or would not have qualified as aging as defined in staff's 2004 white paper. Total retired capacity over the period is 4,698 MW if these are included.

² Also called San Bernardino 1 and 2

³ 2001 generation

Source: Energy Commission Electricity Analysis Office. Does not include South Bay Units 3 and 4 (414 MW) retired at the end of 2009.

CHAPTER 3: Local Reliability Areas and Requirements

California's aging and OTC plants make major contributions to local reliability.⁹ This section discusses local reliability and the steps that are taken to maintain it. Appendix A provides a more detailed discussion of local reliability and how it is maintained. This section also discusses the role that OTC plants play in meeting local reliability needs and the operation of OTC plants in each of five transmission-constrained areas relying on OTC plants: four California ISO-defined LRAs (Big Creek/Ventura, the Greater Bay Area, the Los Angeles Basin, and San Diego) and the portion of the Los Angeles Basin transmission grid that is administered by LADWP.¹⁰ **Figure 9** shows the LRAs identified by the California ISO as well as the LADWP service area. Sixteen of the 19 facilities that consist of or include gas-fired OTC units are located in one of these areas.

Table 3 presents the local capacity requirements (LCRs) for each LRA discussed in this section. The LCR is the amount of local generation that must be procured within the boundaries of the LRA to ensure reliable system operation.

Table 4 summarizes the amount of capacity in each LRA supplied by OTC units (including those that are also aging facilities) as well as aging units that are not OTC. **Table B-1** presents a detailed listing of individual plants and units in each LRA, along with their capacities.

Table 5 combines data from **Table 3** and **Table 4** to illustrate the relative importance of OTC plants to dependable local generation in each LRA. For example, the Greater Bay Area requires 5,344 MW of locally based capacity in 2013 to meet reliability criteria. Because there is a total of 6,992 MW of dependable local generation available (including OTC plants), a surplus of 1,648 MW of local capacity exists for reliability. However, if OTC units are not included, the amount of surplus capacity decreases to 111 MW.¹¹ In three of the LRAs, there

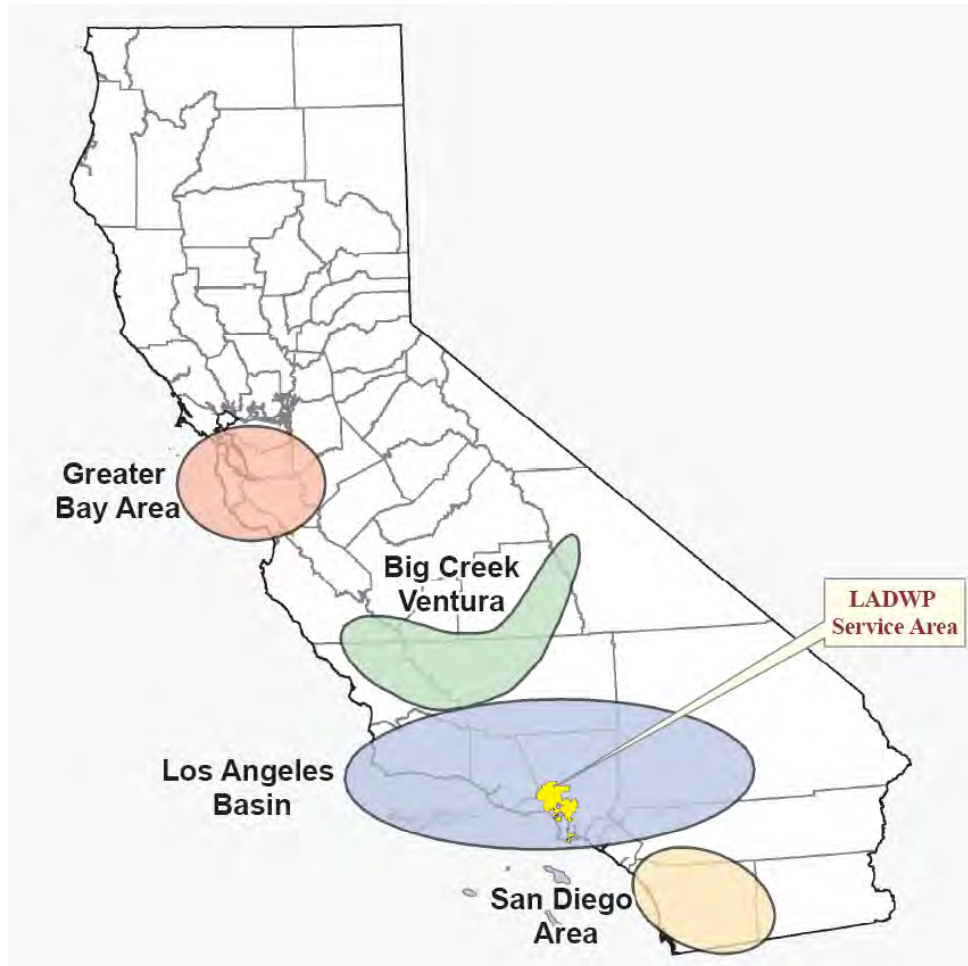
⁹ *Local reliability* refers to the reserves available in a geographic area that has limited amounts of transmission capacity connecting it to other areas and lacks sufficient localized generating capacity to adequately serve the load within that geographic area during peak hours, or when certain contingencies are taken into consideration.

¹⁰ This section does not include a discussion of the two Humboldt units (totaling 107 MW) that use OTC in the California ISO-defined Humboldt LRA. Both of these units are expected to retire when replacement capacity comes on-line in mid- to late-2010.

¹¹ A surplus in the absence of OTC or aging units for any given local reliability area should not be interpreted as indicating that units can be retired without compromising local reliability. As noted above, "sub-area" transmission constraints can require that specific plants within an LRA be maintained and dispatched, even if there is a "surplus" of generation capacity within the LRA as a whole.

is a deficit of local capacity when OTC plants are not included. The California ISO control area portion of the Los Angeles Basin incurs the largest deficit of 3,743 MW.

Figure 9: California ISO Local Reliability Areas



Source: Energy Commission Cartography Unit

Table 3: Local Capacity Requirements by Area (MW)

Local Reliability Area	2009	2011	2013
Big Creek/Ventura	3,178	4,075	3,402
Greater Bay Area	4,791	5,110	5,344
LA Basin	9,728	10,019	8,585
LADWP	3,362*	3,362 *	3,457*
San Diego	3,093	2,324	2,489

* LADWP does not calculate specific LCRs; so as a proxy, Energy Commission staff summed the capacity of all utility-controlled fossil resources in the LA Basin as reported in LADWP's Electricity Resource Planning Form S-1 (includes Harbor, Haynes, Scattergood, Valley units, and gas turbines). It does not include the capacity of local resources operated by Glendale Water and Power and Burbank Water and Power, utilities that also serve load in the LADWP control area.

Source: California ISO, *2011-2013 Local Capacity Technical Analysis Report and Study Results*, Dec. 29, 2008, Tables 2-4. The 2011 and 2013 numbers are forecasts based on specific assumptions about peak loads and generation resources in each LRA and transmission upgrades that are likely in the interim.

Table 4: 2009 Once-Through-Cooled and Aging Plant Capacity by Local Reliability Area (MW)

Local Reliability Area	Once-Through Cooled Capacity	Aging (but not OTC) Capacity	Total Aging and OTC Capacity
Big Creek/Ventura	2,048	0	2,048
Greater Bay Area	1,537	682	2,219
LA Basin	7,109	741	7,850
LADWP	2,636	308	2,944
San Diego	1,647*	0	1,647

* Includes South Bay Units 3 and 4 (414 MW), retired at the end of 2009

Source: Energy Commission Electricity Analysis Office

**Table 5: Comparison of OTC Capacity to Local Generation
Share of Local Capacity Requirements (MW)**

Local Reliability Area	2013 Total Dependable Local Generation	2013 Local Capacity Requirements	2009 OTC Capacity / (OTC + Aging Only Capacity)	Surplus/ (Deficit) with OTC	Surplus/ (Deficit) without OTC
Big Creek/ Ventura	5,160	3,402	2,048 / (2,048)	1,758	(290)
Greater Bay Area	6,992 ¹	5,344	1,537 / (2,219)	1,648	111
LA Basin	11,951	8,585	7,109 / (7,850)	3,366	(3,743)
LADWP	5,205	3,457	2,636 / (2,944)	1,748	(888)
San Diego	2,982	2,489	1,647 / (1,647)	493	(1,154)

¹ Assumes the construction of 210 MW of peaking capacity in San Francisco

Source: California ISO, *2011-2013 Local Capacity Technical Analysis Report and Study Results*, Dec. 29, 2008, Table 4; LA Basin is Energy Commission staff estimate from California ISO 2009 Net Qualifying Capacity report, and includes the Inland Empire Energy Center; LADWP total is from Electricity Resource Planning S-1 forms (Capacity Resource Accounting Table) submitted by LADWP, Burbank, and Glendale.

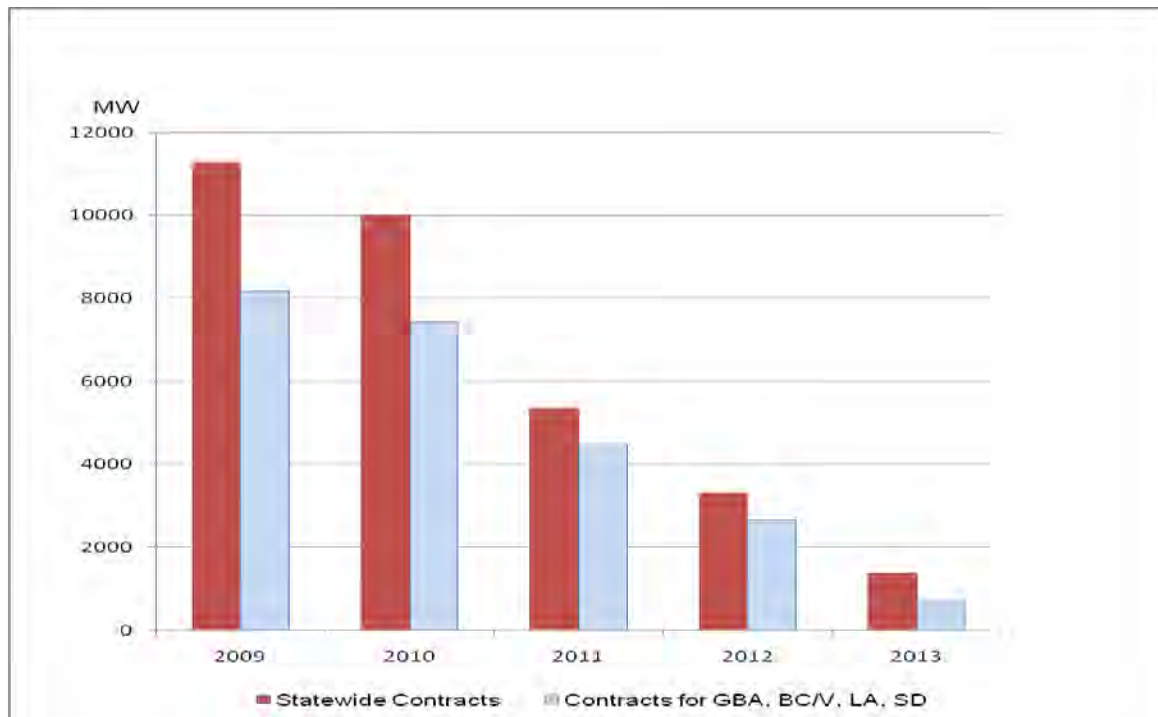
Figure 10 presents the amount of merchant OTC capacity having contracts with investor- and publicly owned utilities and other energy service providers, and the California Department of Water Resources for each year through 2013. The data is presented for statewide capacity and for the LRAs discussed in this paper.

California has a total of 20,400 MW of OTC capacity in 2009, as shown in **Figure 2**. **Table 6** presents the percentages of that capacity having contracts in each LRA annually through 2013.

The higher amount of merchant plant capacity contracted for in 2009 reflects the role that OTC plays in *resource adequacy*¹² (RA). The lower percentage in 2013 reflects the typically short contract length (one or two years) and the possibility that the aging OTC units that provide energy may be replaced by more efficient plants by 2012–2014.

¹² *Resource adequacy* refers to the amount of capacity that a utility has under contract or owns and that contributes toward ensuring that peak loads can be met, including a reliability margin.

Figure 10: Once-Through-Cooled Plant Capacity Under Contract by Local Reliability Area (MW)



Local Reliability Areas: Greater Bay Area (GBA), Big Creek/Ventura (BC/V), Los Angeles Basin (LA), San Diego (SD).

Source: Energy Commission Electricity Analysis Office: from Electricity Resource Plans and Year-Ahead Resource Adequacy submittals

Table 6: 2009 Once-Through-Cooled Capacity Under Contract Through 2013

Local Reliability Area	2009 Once-Through Cooled Capacity (MW)	Percent of 2009 Capacity Under Contract in 2009	Percent of 2009 Capacity Under Contract in 2010	Percent of 2009 Capacity Under Contract in 2011	Percent of 2009 Capacity Under Contract in 2012	Percent of 2009 Capacity Under Contract in 2013
Big Creek/Ventura	2,048	48	45	58	85	0
Greater Bay Area	1,537	98	98	57	13	0
LA Basin	7,109	63	57	34	10	10
San Diego	1,647	58	58	0	0	0
Statewide Total	20,400	54	49	26	16	7

Source: Energy Commission Electricity Analysis Office

CHAPTER 4: Once-Through-Cooled and Aging Power Plant Operation

This section focuses on the operation of OTC power plants during 2008. The discussion is organized by LRA; all of the gas-fired OTC plants lie in an LRA with the exceptions of Moss Landing and Morro Bay, which are discussed last. **Figure B-1** contains scatter plots of the hourly generation of each aging and OTC units during 2008. These scatter plots provide information about when units were called upon to provide energy and indicate the frequency with which they were operated at various output levels.

Local reliability needs are primarily for capacity: A sufficient amount must be available to the control area operator (the California ISO or LADWP) to ensure that reliable service can be sustained during highest load hours in the event of major system component failure (the sudden loss of a large power plant and/or transmission line).

Local reliability needs influence the production of energy from OTC units as well. As OTC units cannot provide energy at a moment's notice unless they are already generating, they are frequently operated at a minimum level to ensure that additional energy will be available when needed for an emergency.¹³ This minimum output will be observed in the middle of the night, even if the capacity is needed only during the next day's highest load hours (the late afternoon), in those cases where the units would be unable to return to service in time if shut down. Many OTC units are slow start¹⁴ and, thus, operate around the clock, even if their capacity is needed only during the day. In those LRAs where almost all of the power plants provide local reliability services and a large share of the capacity is OTC (for example, San Diego), this around-the clock operation of OTC units occurs even during non-summer (low load) months.

OTC units may also be required to operate above minimum levels to prevent line overloading, especially in the LADWP control area. LADWP's major facilities lie at the end of long radial transmission lines; as demand increases along these lines, the line cannot meet demand with imports from one end and local generation at the other end becomes increasingly necessary.

Finally, while aging OTC units tend to be inefficient, high-cost sources of energy, they play a major role in meeting demand during high load hours in the summer. The substantial increases in output from OTC units during the day in the summer are frequently because they are the most economic sources of incremental energy during periods when most of the capacity in the system is already generating.

¹³ Operating at minimum levels to be available when needed is referred to as *spinning reserve*.

¹⁴ Slow start units may take many hours to generate energy from the time they initially begin operating again after being shut down for more than a day or two.

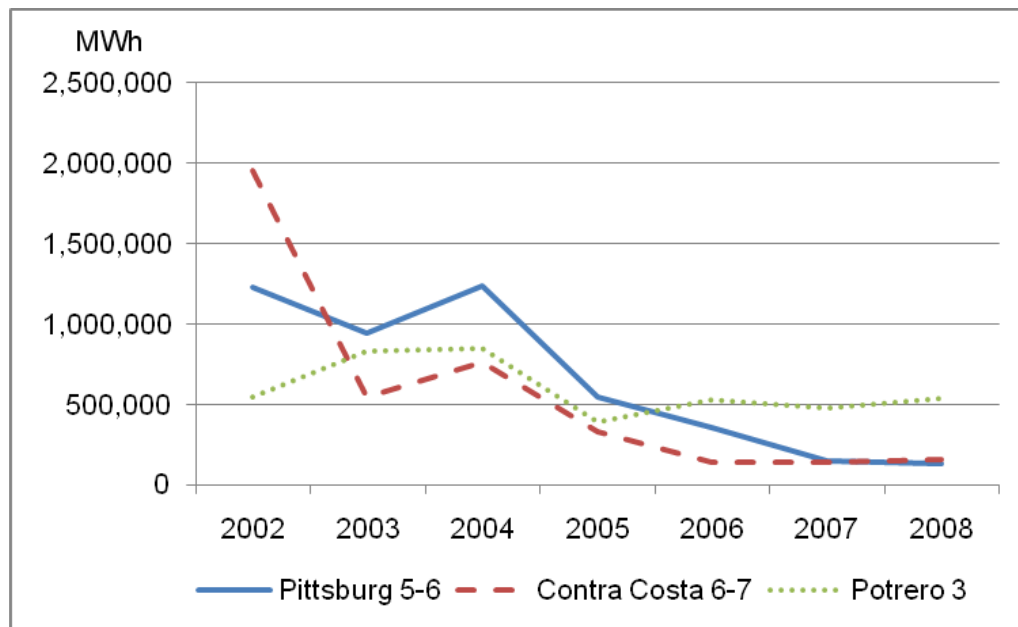
Greater Bay Area

The following OTC units in the Greater Bay Area LRA are discussed in this section:

- Contra Costa 6 and 7 (340 MW each)
- Pittsburg 5 and 6 (325 MW each)
- Potrero 3 (207 MW)

Figure 11 shows that OTC energy generation declined by 78 percent in the Greater Bay Area from 2002-2008. Nearly all of this decline stems from reduced generation at Pittsburg Units 5 and 6 and Contra Costa Units 6 and 7, which reduced their output by 91 percent. (Potrero 3 reduced its generation by only 3 percent over the period.)¹⁵ In the Greater Bay Area, three major facility additions since 2001 made this reduced generation possible: Delta (880 MW), Los Medanos (555 MW), and Metcalf (600 MW). Potrero 3 continues to operate at 2002 levels as it is needed to satisfy a sub-Greater Bay Area transmission constraint. Given Potrero's slow start nature and the fact that it is the sole capacity source in San Francisco, it operates at roughly the same capacity factor across the year and was responsible for 65 percent of the energy produced by OTC units in the Greater Bay Area LRA in 2008.

Figure 11: Greater Bay Area Once-Through-Cooled Annual Generation (2002-2008)



Source: Energy Commission Electricity Analysis Office

¹⁵ Staff notes that generation over the same period from Pittsburg units 1-4 (which last generated in 2003) and Unit 7 (not an OTC facility), which are not included in **Figure 11**, dropped from almost 2.7 mmMWh to 49,000 MWh, a reduction of 98 percent.

Figure 12 illustrates the 2008 hourly operation of Potrero 3, which operates at a minimum load of about 50 MW at night year-round and is ramped up during the day as load conditions in San Francisco, the Greater Bay Area, and Northern California require energy from the unit.¹⁶ The continued operation of Potrero 3 indicates its energy is needed in the event of a transmission line outage that further constrains the delivery of energy into San Francisco proper.¹⁷

Hourly Generation Scatter Plots

Figure 12 is an example of a scatter plot that shows the output of a power plant during every hour of the year. A dense, dark cluster of observations indicates that the unit spends multiple hours at that level of output; Potrero 3 is frequently operated at just under 50 MW for several days, increasing its output for a handful of hours as necessary. **Figure 16** shows that Huntington Beach 1 may spend hours at roughly 20 MW, then “reset” to 60 MW; a review of the data indicates that it is frequently operated overnight at the lower level and is then moved to the higher level during the later morning and afternoon. Neither plant is capable of shutting down at night and being available the next day, thus the lack of observations along the horizontal axis during periods in which it is operated. **Figure 22** illustrates the operation of a plant that spends a large number of hours at full output; the combined cycle at Haynes is routinely cycled from 350 MW at night to 550 MW during the day.

In contrast, the units at Pittsburg and Contra Costa are needed for spinning reserve or energy during far fewer hours, when loads are highest, or newer units in the Greater Bay Area are down for maintenance. Scatter plots illustrating the operation of units at Pittsburg and Contra Costa can be found in **Figure B-1**.

The frequency with which Potrero 3 is run at minimum load is further illustrated in **Figure 13**. The unit was dispatched at minimum load for more than 5,000 hours during the year.

The importance of OTC facilities in the Greater Bay Area can be seen from **Table 5**. In a study of local capacity needs,¹⁸ the California ISO projected a local capacity requirement for the Greater Bay Area of 5,344 MW in 2013, with available capacity of 6,992 MW.¹⁹ When OTC plants are assumed to be available, the surplus capacity in 2013 is 1,648 MW. This decreases to 111 MW if OTC units are not counted.

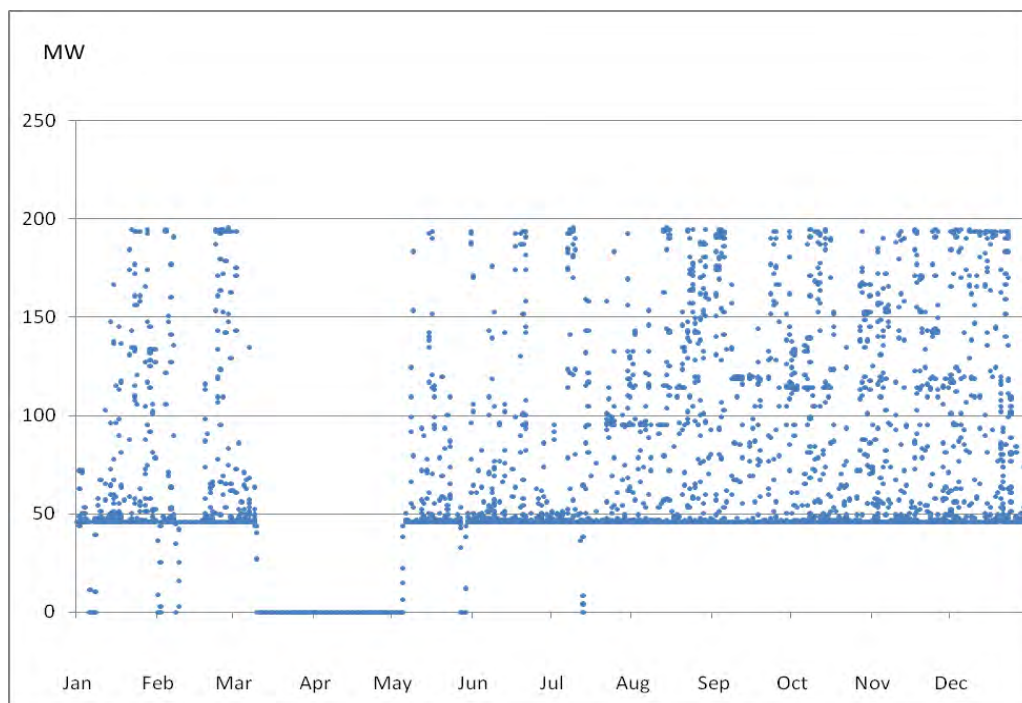
¹⁶ The unit was not dispatched during April, the month in which San Francisco and Northern California loads are lowest. During this period, the gas turbines at Potrero (units 4, 5, and 6) were able to provide the local reliability services needed for the San Francisco sub-area.

¹⁷ Potrero’s position as the sole major facility in a sub-area is similar to that of the Humboldt units, which displayed a similar “around the clock, around the year” pattern. See **Figure B-1**.

¹⁸ *2011-2013 Local Capacity Technical Analysis Report and Study Results*, California ISO, December, 2008.

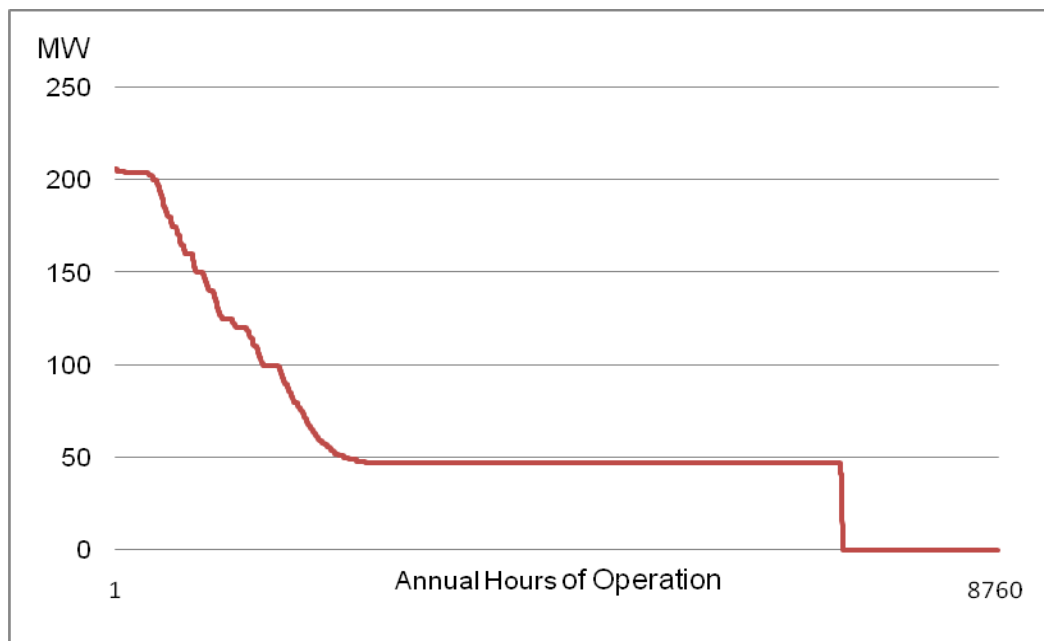
¹⁹ The California ISO assumed that 210 MW of peaking units would be constructed to serve San Francisco.

Figure 12: Potrero 3 Hourly Operation (2008)



Source: EPA Continuous Emissions Monitoring Survey data.

Figure 13: Potrero 3 Load Duration Curve (2008)



Source: Energy Commission Electricity Analysis Office

The completion of the Trans-Bay cable in 2010 is expected to eliminate the need for local reliability services from Potrero 3, as well as the combustion turbines at the site (Units 4, 5, and 6).²⁰ This transmission line will allow for the transfer of up to 400 MW from Pittsburg to San Francisco, effectively providing insurance against the failure of the existing lines over which energy is imported into the city. PG&E's Gateway unit (530 MW), located on the site of the Contra Costa power plant, came on-line in February 2009 and is expected to allow one of the aging Contra Costa units to be released from its obligation to provide local reliability services. The remaining unit at Contra Costa and those at Pittsburg will continue to be needed for local reliability until replacement capacity is built in the Greater Bay Area LRA, upgrades are performed on the bulk transmission system that allow additional energy to be imported into the LRA, or some combination of the two.²¹ The SWRCB has proposed a compliance deadline to reduce/eliminate the use of once-through-cooling at Potrero 3 of one year after the effective date of the policy and December 2017 for the units at Pittsburg and at Contra Costa

Los Angeles Basin—California ISO Control Area

The following OTC units in the Los Angeles Basin LRA are discussed in this section:

- Alamos 1 and 2 (175 MW each)
- Alamos 3 (326 MW)
- Alamos 4 (324 MW)
- Alamos 5 and 6 (485 MW each)
- El Segundo 3 and 4 (335 MW each)
- Huntington Beach 1 and 2 (215 MW each)
- Huntington Beach 3 and 4 (225 MW each)
- Redondo Beach 5 (179 MW)
- Redondo Beach 6 (175 MW)
- Redondo Beach 7 (493 MW)
- Redondo Beach 8 (496 MW)

²⁰ The air-cooled gas turbines at Potrero (Units 4, 5, and 6) will continue to be needed.

²¹ On September 2, 2009, PG&E entered into a 10-year power purchase agreement with the Mirant Corporation for energy from its proposed Marsh Landing facility. At such time that Marsh Landing comes on-line, it is expected to provide local reliability services that will allow for the retirement of the remaining units at Contra Costa.

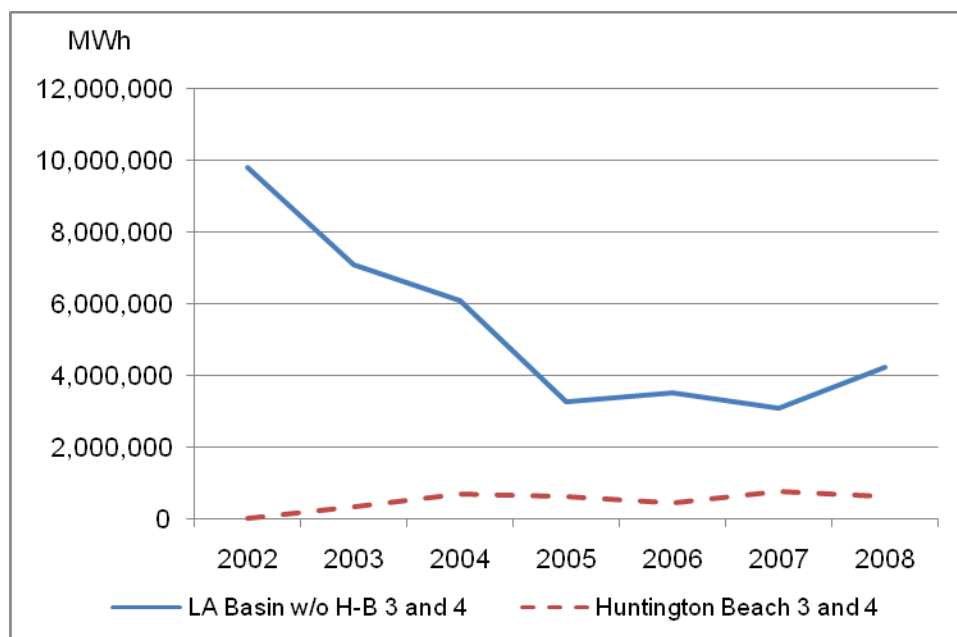
Figure 14 shows that energy generated by OTC units in the Los Angeles Basin LRA decreased approximately 57 percent from 2002 to 2008. Huntington Beach Units 3 and 4 are shown separately. Although they were taken out of service in the mid 1990s, they were retooled several years later and then placed back into service; therefore, they are used more than typical aging facilities.

Table 5 shows the contribution of the OTC facilities in the Los Angeles Basin LRA and their importance for maintaining reliability. Relative to local capacity requirements and the amount of dependable local generation, OTC facilities contribute to a surplus of 3,366 MW. Without their capacity, the surplus becomes a deficit of 3,743 MW.

Energy from Los Angeles Basin OTC units was roughly constant during 2005–2008. Absent plant retirements, it is not likely to fall over the next few years for several reasons. Much of the energy produced by these units is needed to meet local reliability requirements, as well as provide *inertia* to maintain adequate levels of import capability into Southern California.²² When these units are needed to meet local spinning reserve requirements, they must be turned on and operated at minimum set points around the clock to be available and increase output as needed during the day. New generation construction outside the Los Angeles Basin would contribute to Southern California’s need for adequate inertia but could not provide local reliability services.

²² The rotation of generation turbines in Southern California produces *inertia*, necessary to stabilize the transmission grid and allow energy to be imported into the region. The OTC units are primarily steam turbines, which provide more inertia per MW of capacity than combined-cycles or other generation technologies.

Figure 14: Los Angeles Basin Once-Through-Cooled Annual Generation (2002-2008)



Source: Energy Commission Electricity Analysis Office

New power plant construction in the Los Angeles Basin is hampered by the cost and limited availability of air emissions credits for new generation facilities.²³ While there is room to retire some amount of capacity in the Los Angeles Basin and still meet local capacity requirements, a substantial share of existing capacity will have to remain on-line and continue to provide local reliability services unless replacement capacity is forthcoming.²⁴

Figure 15 compares monthly generation from OTC facilities in the Los Angeles Basin during 2002 and 2008 (excluding Huntington Beach Units 3 and 4). Again, generation is lower in 2008 than in 2002, but the OTC units were used for replacement energy when the San Onofre nuclear plant was out of service in June 2002 and again in November 2008.

²³ As a result of a recent court decision, the South Coast Air Quality Management District made significant changes to its permitting program. These changes prevent it from issuing permits for new construction or modification of equipment that increases air pollution unless the applicant provides its own Emission Reduction Credits, rather than obtaining such credits from the District. On the open market, these credits are costly and very difficult to obtain. For more details, see *Potential Impacts of the South Coast Air Quality Management District Air Credit Limitations and Once-Through Cooling Mitigations on Southern California's Electricity System*, California Energy Commission (CEC-200-2009-002-SD, March 2009).

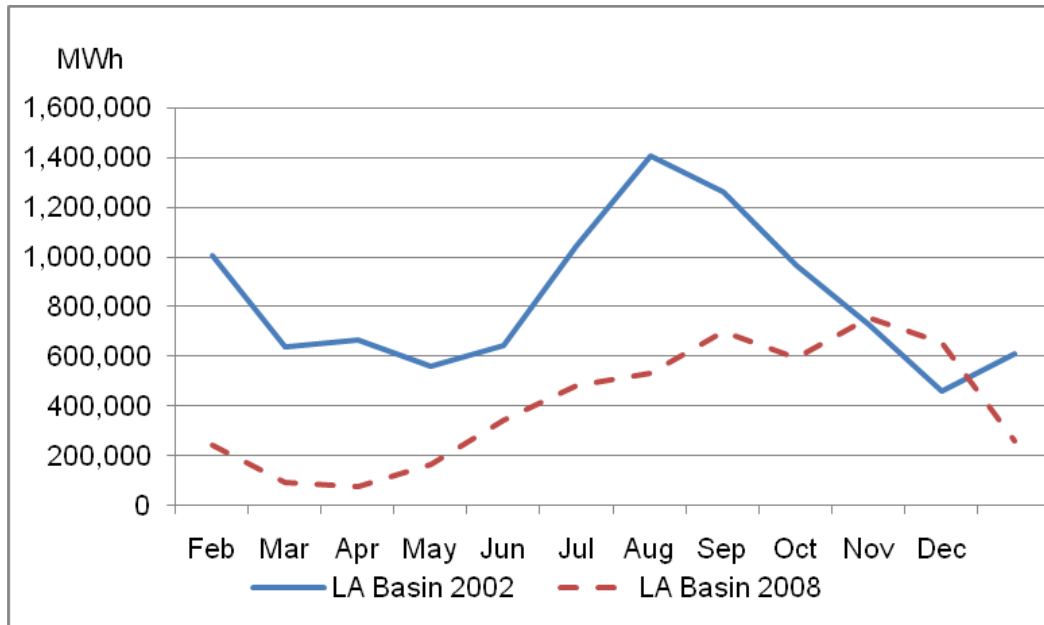
²⁴ The exact amount of capacity that could retire without threatening local reliability is a function of the location of the capacity to be retired and where new capacity would be located. There are no recent transmission studies that provide information regarding the potential retirement of existing OTC plants in the LA Basin.

Figure 15 also illustrates the increased reliance on OTC units during the summer. While this was less the case in 2008 than six years earlier—largely a result of the construction of new, more efficient power plants throughout Southern California—it remains true today. The aggregate capacity factor for the OTC units in February—April 2008 was less than 3 percent; the corresponding figure for August—October was slightly less than 20 percent.

While much of the energy produced by OTC units in the Los Angeles Basin LRA during the summer is economic—it may be the least-cost energy available during high load hours, a portion of it follows from local capacity needs. As loads in the entire SCE area rise, an increasing amount of OTC capacity in the LRA is needed to meet thermal and voltage constraints. At loads from 22,000–23,000 MW, 1,360 MW or more are needed from the OTC units in the LRA, when loads exceed 24,000 MW, more than 2,800 of MW capacity from OTC units must be available.

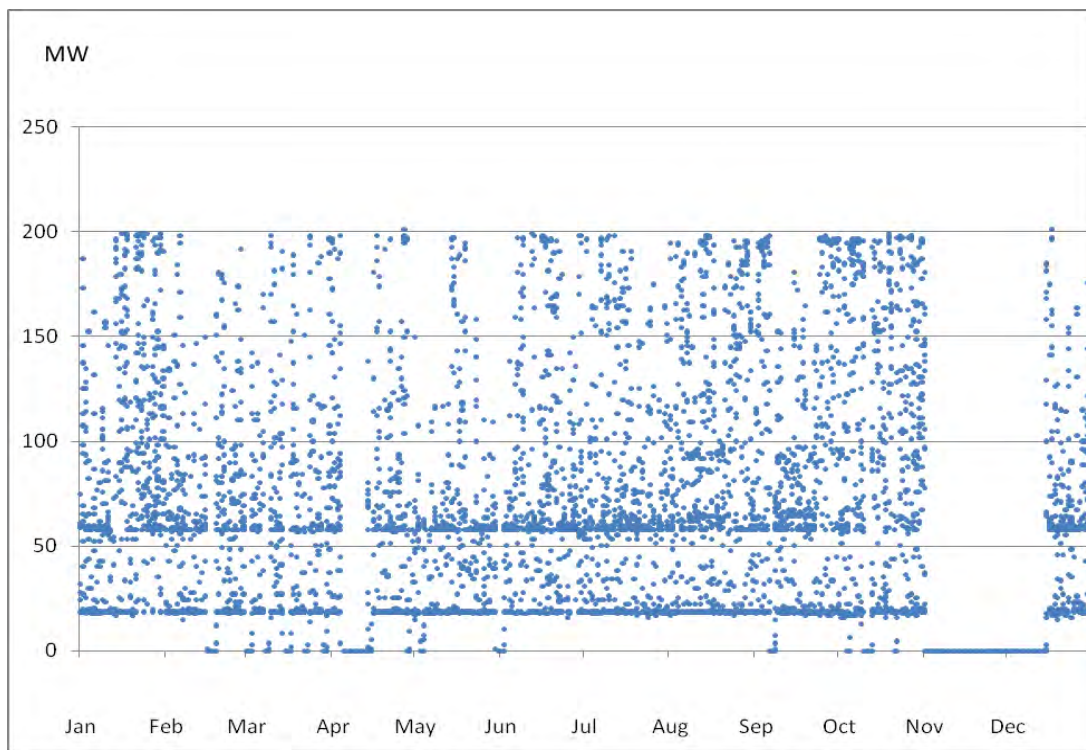
In 2008, OTC unit capacity factors in the California ISO portion of the LA Basin ranged from 1 percent (Redondo Beach 6) to 28 percent (Huntington Beach 1). Units at Huntington Beach and three of the units at Alamitos (Units 3–6) provided 73 percent of the energy from OTC units in the Los Angeles Basin. The generation profile for Huntington Beach 1 is presented in **Figure 16**; it reflects minimum set points at 20 MW and 50 MW. The profile for Huntington Beach 2 is similar, although it was not operated in April–May and had a slightly slower capacity factor (20 percent). Units 1 and 2 were used more often than Units 3 and 4 despite having higher heat rates as use of the latter units would have required operating at minimum levels of 80 MW. The output profiles of all of these units are presented in scatter plot form in **Figure B-1**.

**Figure 15: Los Angeles Basin Once-Through-Cooled
Monthly Generation (2002 and 2008)**



Source: Energy Commission Electricity Analysis Office

Figure 16: Huntington Beach 1 Hourly Operation (2008)

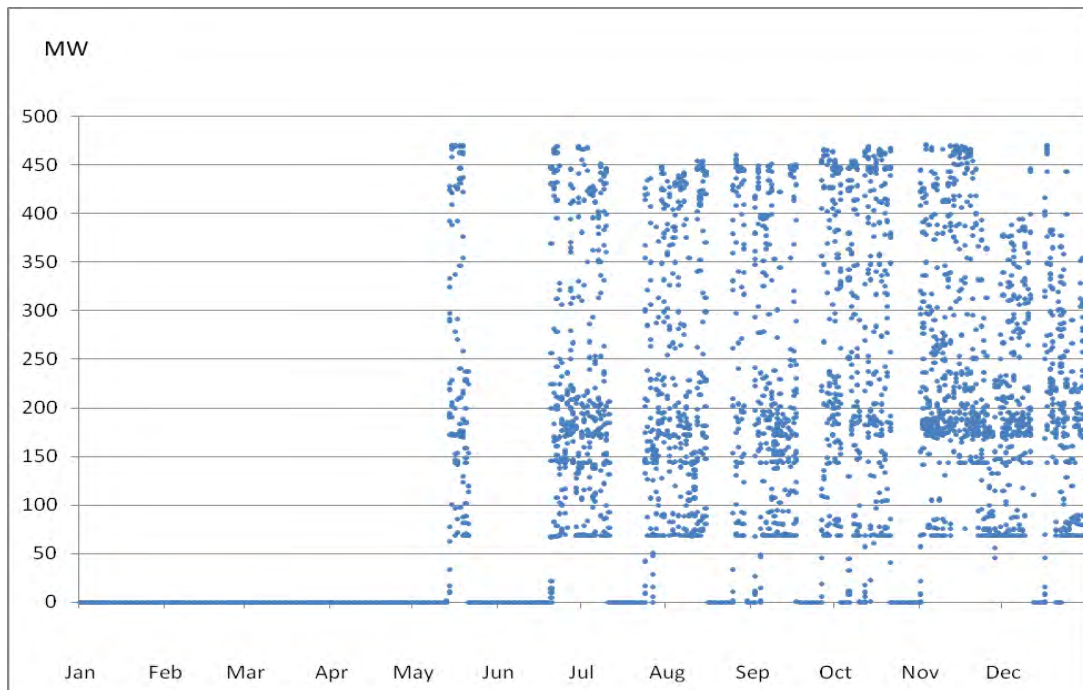


Source: Environmental Protection Agency Continuous Emissions Monitoring Survey data.

Units 3 and 5 had the highest capacity factors of the units at Alamitos (23 and 21 percent, respectively). Alamitos 5 produced more energy than any other OTC unit in the Los Angeles Basin (18 percent of the total energy from OTC units). As **Figure 17** shows, it provided energy during the summer high load period and when San Onofre 3 was unavailable in October–December, due in part to its low heat rate relative to other OTC units²⁵ ($\approx 10,200$ Btu/kWh). The corresponding diagram for Alamitos 3 (**Figure B-1**) shows that the unit was dispatched less in October–December, but more in April and May, a result of its having a higher heat rate but a low minimum output level (less than 25 MW). This encourages dispatch when the capacity of the unit, but not the energy, is needed for local reliability.

Alamitos 1 and 2 and all four of the units at Redondo Beach (5–8) were operated at capacity factors of 4 percent or less during 2008. Alamitos 1 and 2 and Redondo Beach 5 and 6 have very high heat rates (only Alamitos 2, at 14,600 Btu/kWh is less than 17,000 Btu/kWh). Redondo Beach 7 and 8 have relatively competitive heat rates (10,200 and 10,900 Btu/kWh, respectively) but have a high minimum operating level (120 MW) and are thus expensive sources of spinning reserves. The output of all of these units is presented in **Figure B-1**.

Figure 17: Alamitos 5 Hourly Operation (2008)



Source: EPA Continuous Emissions Monitoring Survey data.

Two of the aging plants identified for retirement by the Energy Commission in 2004 that do not use OTC are in the California ISO portion of the Los Angeles Basin: Broadway and

²⁵ The relatively lower heat rate means that it operates more efficiently and thus more cheaply than the other units.

Etiwanda. Their operations are discussed in the last section of this chapter “Aging Power Plants That Do Not Use OTC.”

The California ISO portion of the Los Angeles Basin currently has capacity in excess of that needed to meet local capacity requirements, which would allow for the retirement of a share of the OTC capacity in the basin. Beyond some threshold level of retirements, replacement capacity either inside or outside the basin would be needed to meet local and zonal (Southern California) capacity requirements. The amount of replacement capacity needed within the basin could be reduced over a longer period with upgrades to the transmission system, which would allow additional energy to be imported.

No recent studies exist on the impacts of capacity retirement at any one or more OTC units. Such studies are sensitive to assumptions about demand and the precise location and quantity of generation throughout the California ISO portion of the Los Angeles Basin. In addition, they are complicated by the need to consider whether the nuclear plant at San Onofre continues to operate past the expiration of its license in 2022, as its closure would dramatically alter the need for capacity in the basin.

The repowering or replacement of OTC capacity in the California ISO-defined Los Angeles Basin LRA is complicated by several factors, including the number of units and sizable amount of capacity involved, the shortage of emission credits, and the time needed to develop transmission alternatives that would allow the replacement of in-basin capacity with out-of-basin plants, including renewable facilities. As a result, the SWRCB has proposed to set a compliance deadline of December 2020 for Alamitos, Huntington Beach, and Redondo Beach. The proposed deadline for El Segundo is December 2015, a result of a repowering having been already permitted and the project having secured a long-term power purchase agreement with Southern California Edison.

Los Angeles Basin—Los Angeles Department of Water and Power Control Area

The following OTC units in the LADWP control area of the Los Angeles Basin are discussed in this section:

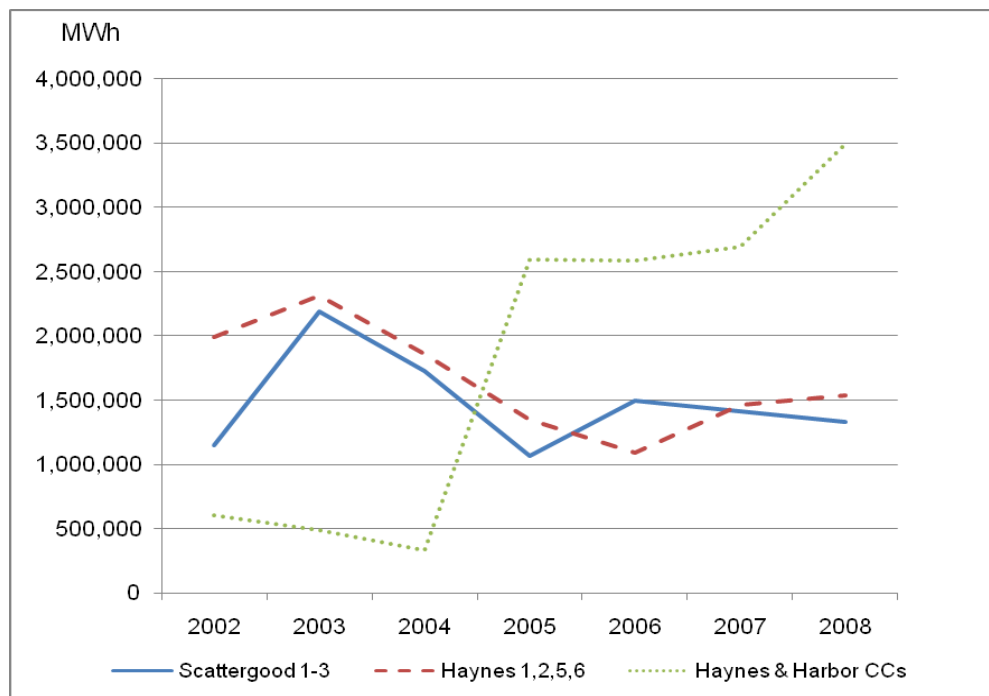
- Harbor combined-cycle (227 MW)
- Haynes 1 and 2 (230 MW each)
- Haynes 5 (343 MW)
- Haynes 6 (243 MW)
- Haynes combined-cycle (560 MW)
- Scattergood 1 and 2 (179 MW each)
- Scattergood 3 (445 MW)

LADWP operates three facilities that use OTC: Haynes, Scattergood, and the combined-cycle at Harbor. Totalling 2,636 MWs, these units provide nearly 40 percent of LADWP's capacity needs and are essential for maintaining local reliability in the LADWP control area.

Figure 18 shows that the usage of the aging OTC units at Scattergood and Haynes has remained roughly constant over 2004–2008. The increase in total OTC generation is a result of the new combined-cycle at Haynes coming on-line in late 2004. Output from the Harbor combined-cycle is minimal.

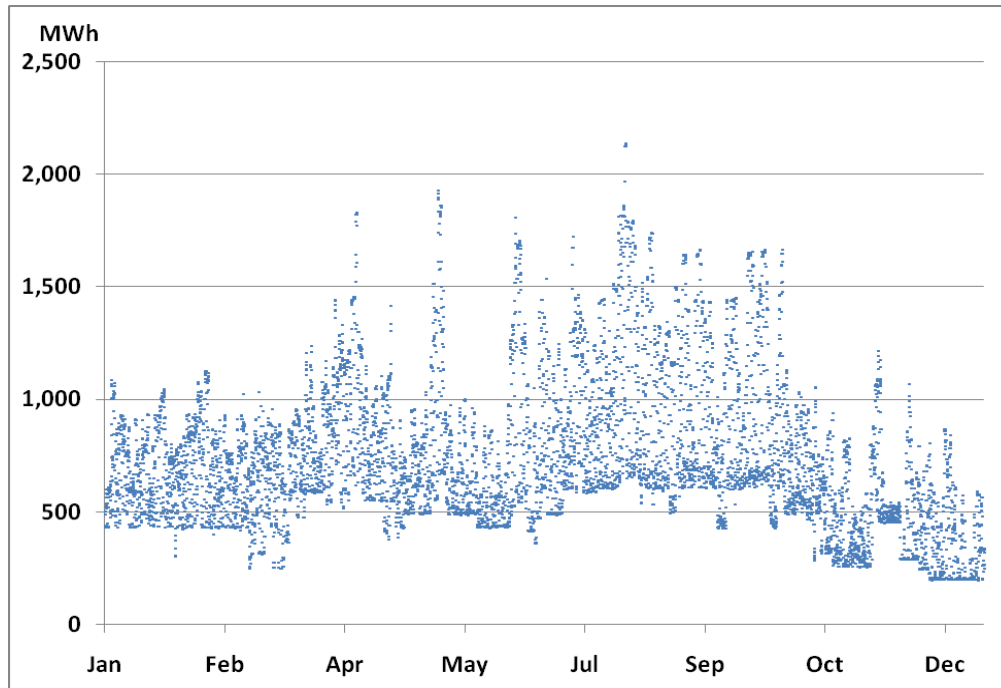
Figure 19 illustrates the extent to which LADWP depends upon generation from its OTC facilities to meet customer demand. Amounts of energy from OTC units increased primarily during the high load summer period, as well as during April when Intermountain 2 was unavailable. A heat wave on April 12–13 caused the generation spike in mid-April, when Los Angeles Basin temperatures reached the mid 90s. Temperatures moving to the high 90s, May 15–19, caused the spike in mid-May. June 19–22 witnessed temperatures over 105 degrees.

Figure 18: LADWP Once-Through-Cooled Annual Generation (2002-2008)



Source: Energy Commission Electricity Analysis Office

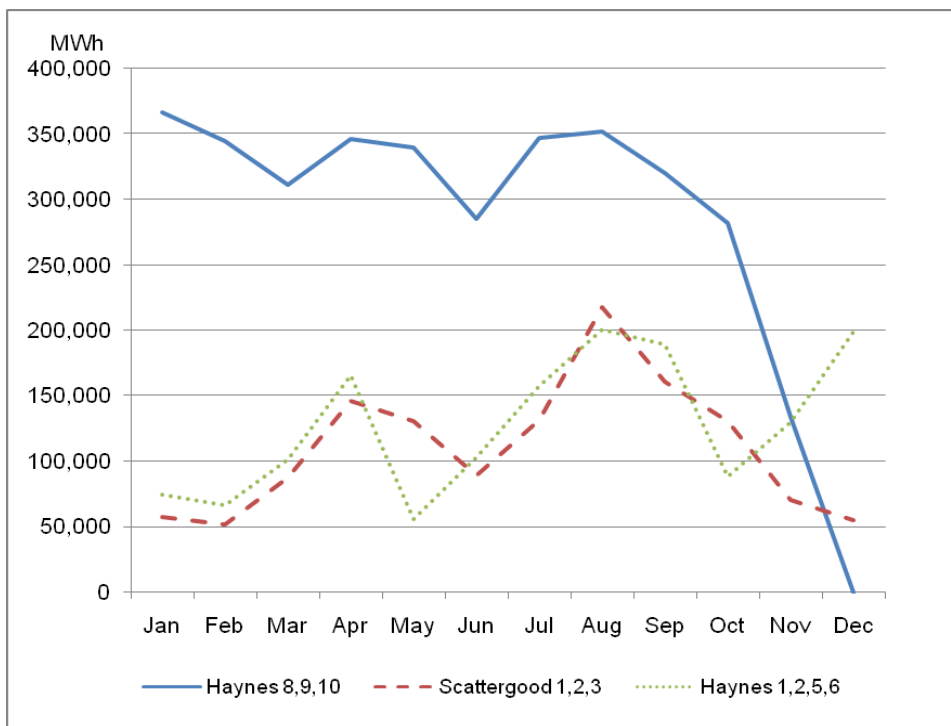
**Figure 19: Hourly Generation from LADWP Once-Through-Cooled Units
(Jan–Dec 2008)**



Source: EPA Continuous Emissions Monitoring Survey data.

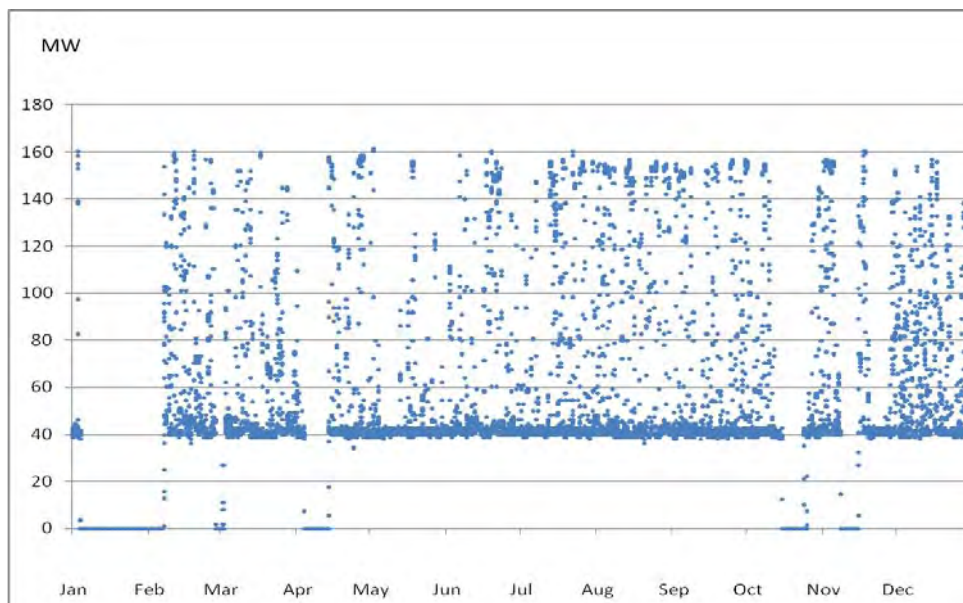
Figure 20 displays monthly energy from Scattergood (Units 1, 2, and 3), the aging Haynes (Units 1, 2, 5, and 6) and the Haynes combined-cycle (Units 8, 9, and 10) during 2008. Energy from the Scattergood and the aging Haynes Units is needed primarily in the summer, (Scattergood peaked at a 36 percent capacity factor in August), although this is masked somewhat by their high values during April, which reflect the unavailability of Intermountain Unit 2 from March 28–April 29. Scattergood’s 445 MW Unit 3 was used during the high load months of July through October, cycling from 50 MW at night to 300 MW (and occasionally 430 MW) during the day. (See Scattergood 3’s 2008 hourly operation in **Figure B-1**.) It is rarely, if ever, used outside of those high load months. As **Figure 21** illustrates, Scattergood Unit 1 (one of two 179 MW units) is on almost all the time to meet the facility’s commitment to burn digester gas from the Hyperion Wastewater Treatment Plant, cycling from 50 MW at night to 150 MW during the day if additional energy is needed. Unit 2 is operated as needed to complement Unit 1. Both of the smaller units operate in such a cycling manner when LADWP loads approach or surpass 5,000 MW or a unit at its Intermountain facility is out for maintenance.

Figure 20: LADWP Once-Through-Cooled Monthly Generation (2008)



Source: Energy Commission Electricity Analysis Office

Figure 21: Scattergood Unit 1 Hourly Operation (2008)

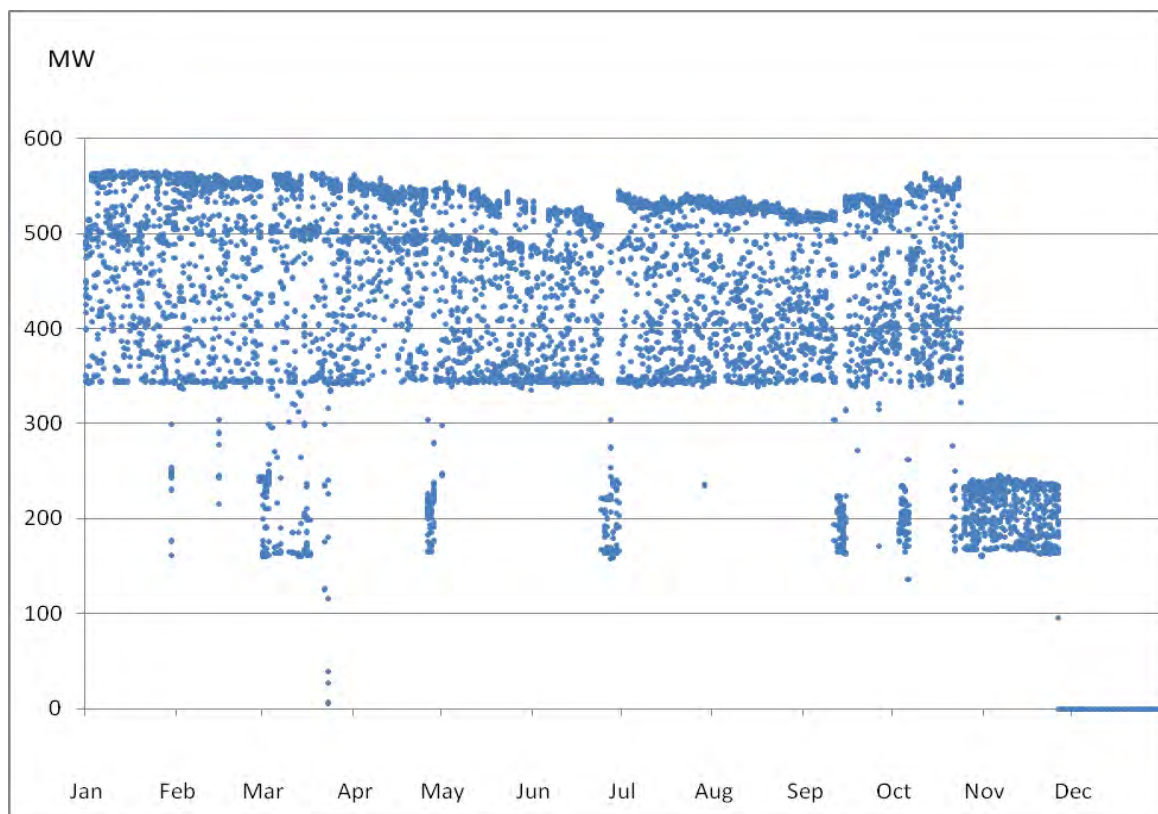


Source: EPA Continuous Emissions Monitoring Survey data.

The aging Haynes Units also increased generation in November and December (while the Haynes combined-cycle was partially and fully out, respectively, in those months). The remaining OTC facility, the combined-cycle at Harbor, operated little in 2008, with a capacity factor of 3 percent. As **Figure 22** shows, the Haynes combined-cycle (Units 8, 9, and 10) operates around the clock and is cycled from 350 MW at night to 550 MW during the day. Its capacity factors in January through May, July, and August were 80–85 percent.

Staff has insufficient information to determine what share of generation from LADWP's OTC units is for local reliability needs, but it is likely to be substantial. The slow-start nature of most of LADWP's OTC units, the radial configuration of LADWP's transmission system (Harbor, Haynes, and Scattergood all lie at the end of radial transmission lines.), and very high loads along these lines combine to require not only capacity to insure against line failure, but also energy from that capacity at all hours and in greater amounts as loads increase.

Figure 22: Haynes Combined-Cycle Hourly Operation (2008)



Source: EPA Continuous Emissions Monitoring Survey data.

As noted in the City of Los Angeles's *Climate LA Program Document 2008*,²⁶ LADWP plans to replace the steam boiler units at Haynes 5 and 6 with simple-cycle turbines; Scattergood

²⁶ <http://www.lacity.org/ead/environmentla/pdf/ClimateLA%20Program%20document%202012-08.pdf>

Units 1 and 2 will be replaced with combined-cycle turbines and/or simple-cycle turbines. LADWP's Electricity Resource Planning Form S-1 submitted to the Energy Commission in February 2009 indicates that Haynes 5 and 6 will be replaced with 6,100 MW turbines by the summer of 2013. The filing also indicates that Scattergood 1 and 2 will be replaced by the summer of 2015 with a 260 MW combined-cycle and a 100 MW turbine. Staff has insufficient information to determine what share, if any, of OTC plant capacity could be retired without threatening local reliability, but believes that it is likely to be small, absent replacement capacity or transmission upgrades that would allow for more energy imports. The planned replacements at Scattergood and Haynes are expected to reduce the need for energy from OTC plants, largely through allowing dispatch of units closer to the point in time they are needed.

The SWRCB has proposed once-through-cooling compliance deadlines of December 2015 for the Haynes facility and December 2017 for Harbor and Scattergood. Because of its relative efficiency, the combined-cycle at Haynes is eligible to apply to use alternative compliance mechanisms.

Big Creek/Ventura

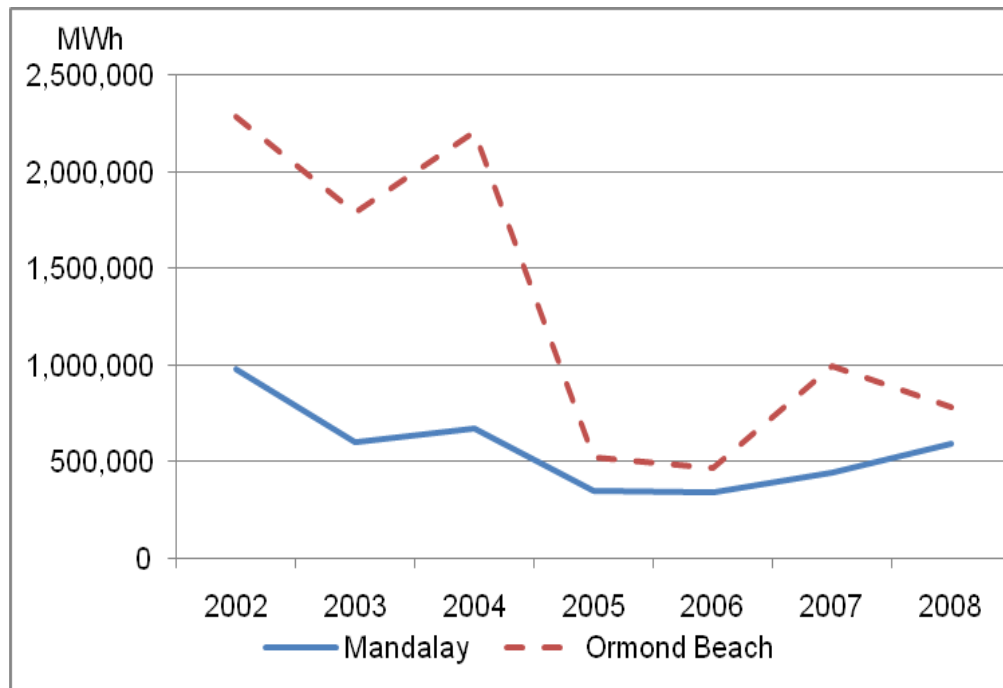
The following OTC units in the Big Creek/Ventura LRA are discussed in this section:

- Mandalay 1 and 2 (218 MW each)
- Ormond Beach 1 and 2 (806 MW each)

Figure 23 shows the decrease in generation from the two OTC plants in the Big Creek/Ventura LRA since 2002. Both Mandalay and Ormond Beach are also aging facilities, used only as needed for local reliability purposes and to meet demand during high load hours in the summer. During 2008, they operated at 15 and 5 percent capacity factors, respectively. **Figure 24** shows their monthly operation during 2002 and 2008, when both facilities were used mostly during the summer season but at greatly reduced levels by 2008.

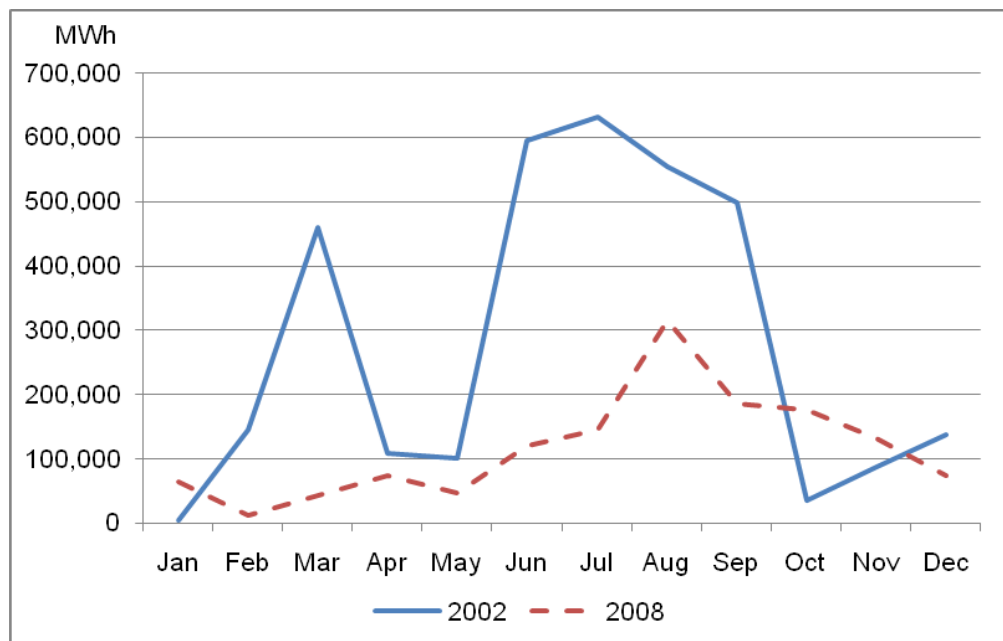
Table 5 shows the significance the OTC units have for reliability in the Big Creek/Ventura LRA, as their absence results in a net deficit of 290 MW in dependable local generation. No current studies exist that estimate OTC capacity that could be retired in the LRA and the combination of replacement capacity and transmission upgrades that would be needed to maintain local reliability. The size of Ormond Beach alone indicates that retirement of one or both of the units would have a substantial impact on zonal and system reliability.

Figure 23: Big Creek/Ventura Once-Through-Cooled Annual Generation (2002-2008)



Source: Energy Commission Electricity Analysis Office

Figure 24: Big Creek/Ventura Aging and Once-Through-Cooled Monthly Generation (2002 and 2008)



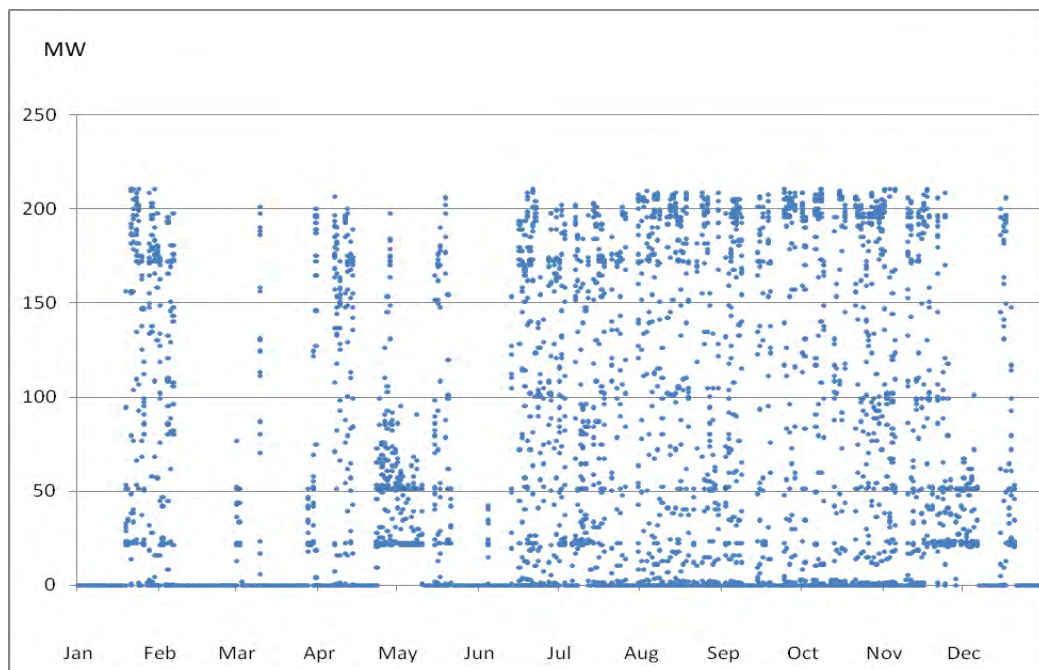
Source: Energy Commission Electricity Analysis Office

Figure 25 illustrates the manner in which Mandalay 2 was used during 2008; it had a capacity factor of 19 percent. The density of data points indicates that the unit frequently operated at minimum set points of 20 and 50 MW and at full output and that it was turned off at night when not needed. Mandalay 1 (12 percent capacity factor) was used in a similar fashion, although less frequently during the first half of the year; its output is shown in **Figure B-1**.

In comparison to the units at Mandalay, those at Ormond Beach were operated sparingly; Unit 1, whose output is graphed in **Figure 26**, had a 4 percent capacity factor. Unit 2 was operated in a similar fashion (with a capacity factor of 7 percent), although with greater frequency during the summer. Notably, the units at Ormond Beach are not turned off at night when needed on consecutive days and have minimum set points of approximately 100 MW.

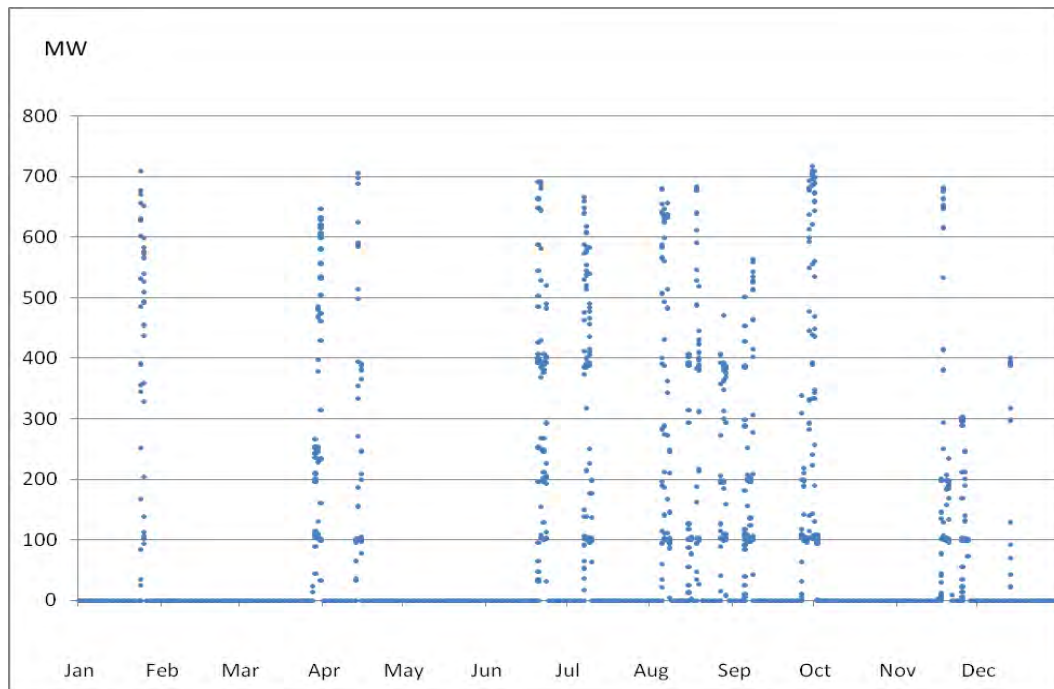
The SWRCB has proposed a compliance deadline for the elimination of the use of OTC of December 2020 for Mandalay and Ormond Beach.

Figure 25: Mandalay 2 Hourly Operation (2008)



Source: EPA Continuous Emissions Monitoring Survey data.

Figure 26: Ormond Beach 1 Hourly Operation (2008)



Source: EPA Continuous Emissions Monitoring Survey data.

San Diego

The following OTC units in the San Diego LRA are discussed in this section:

- Encina 1 (107 MW)
- Encina 2 (104 MW)
- Encina 3 (110 MW)
- Encina 4 (300 MW)
- Encina 5 (330 MW)
- South Bay 1 and 2 (136 MW each)
- South Bay 3 (210 MW)
- South Bay 4 (214 MW)

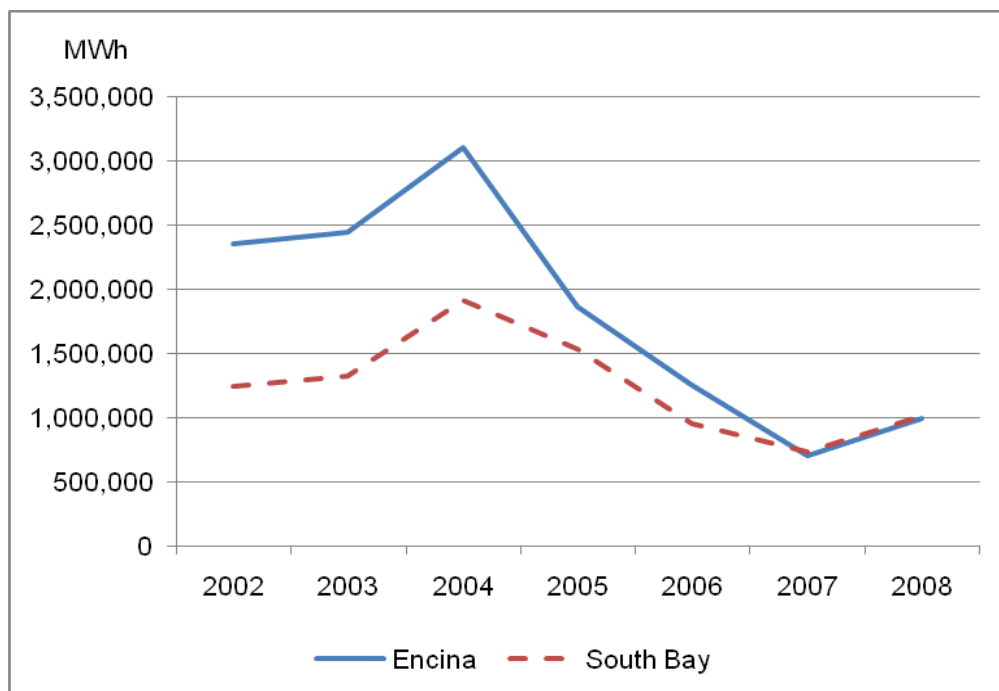
Units at the Encina (951 MW total) and South Bay (696 MW total) power plants range in age from 31–45 years old.

Figure 27 illustrates that the output of both Encina and South Bay has declined substantially since 2002, when the plants operated at capacity factors of 37 percent and 31 percent

respectively. By 2008, these capacity factors had fallen to 12 percent and 17 percent respectively. This is, in part, because more efficient generation developed across the state during the past seven years, but is largely a result of the construction of the Palomar Energy Project, a 546 MW combined-cycle located in the San Diego LRA that came on-line in April 2006. Before the operation of Palomar, all generation units in the San Diego LRA were needed for local reliability. Encina and South Bay plants were frequently called upon to provide spinning reserve; this service is now primarily provided by Palomar.

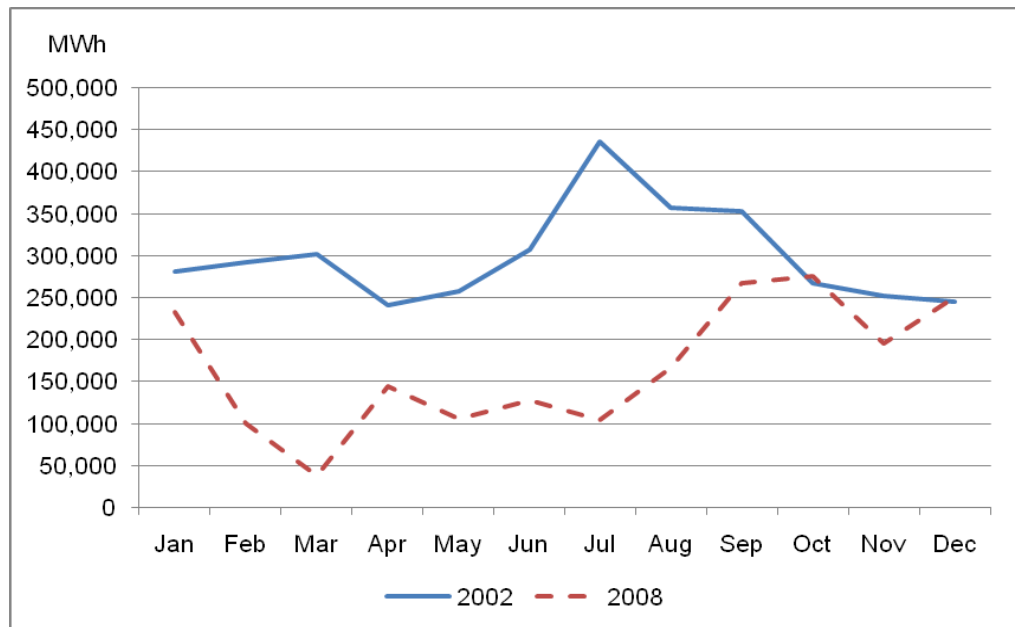
Figure 28 demonstrates that energy from OTC units in San Diego continues to be needed during the summer; relatively high needs during the last quarter of 2008 may stem from reduced output at San Onofre, just north of the San Diego LRA. Because almost all units in the San Diego LRA are needed for local reliability, plus their slow-start nature, units at Encina and South Bay produce significant quantities of energy in non-summer months as well.

Figure 27: San Diego Once-Through-Cooled Annual Generation (2002–2008)



Source: Energy Commission Electricity Analysis Office

Figure 28: San Diego Aging and Once-Through-Cooled Monthly Generation (2002 and 2008)

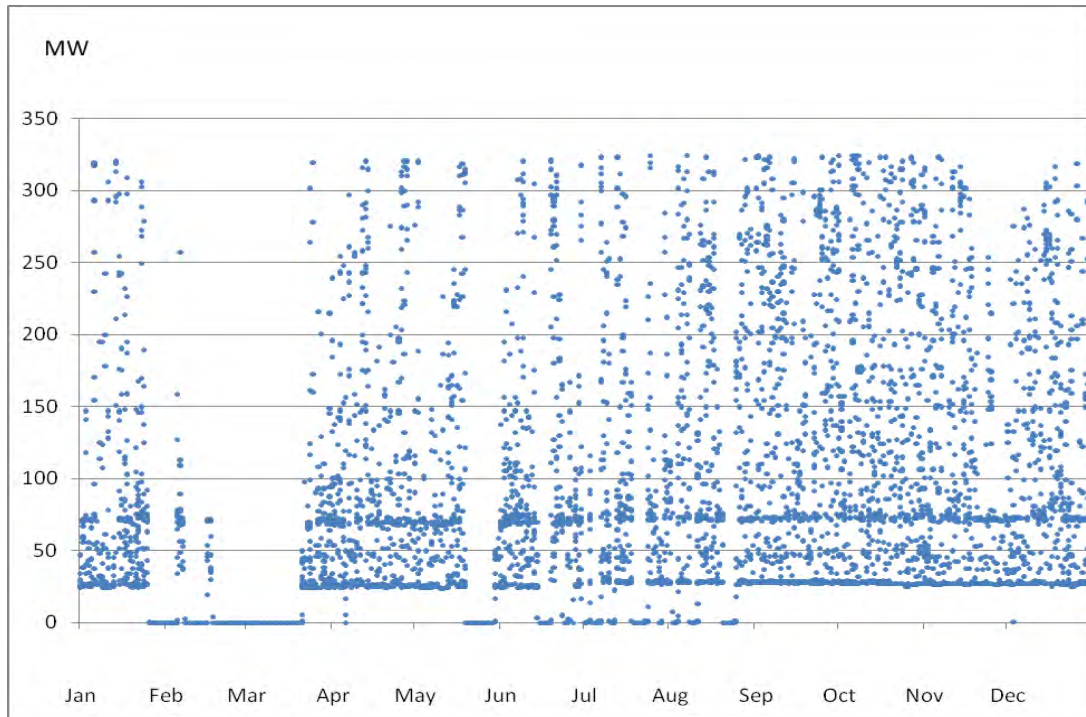


Source: Energy Commission Electricity Analysis Office

Because units at both Encina and South Bay are needed for local reliability and have very slow start-up times, it is necessary to operate several of these around the clock. At night, and frequently throughout the day, these units are run at minimum load just to ensure that additional energy will be available if needed during an emergency (for example, the outage of part of the Southwest Power Link, which connects San Diego to power plants to the east, or a unit at Palomar). **Figure 29** illustrates the operation of Encina 5 during 2008, reflecting operation throughout the year except during the spring, when electricity demand is at its lowest. The density of data points indicates that the unit was frequently dispatched at its minimum set points of 25 and 70 MW. This is verified by **Figure 30**, the load duration curve for the unit in 2008, which indicates that the unit spent almost half of 2008 at its minimum set points.

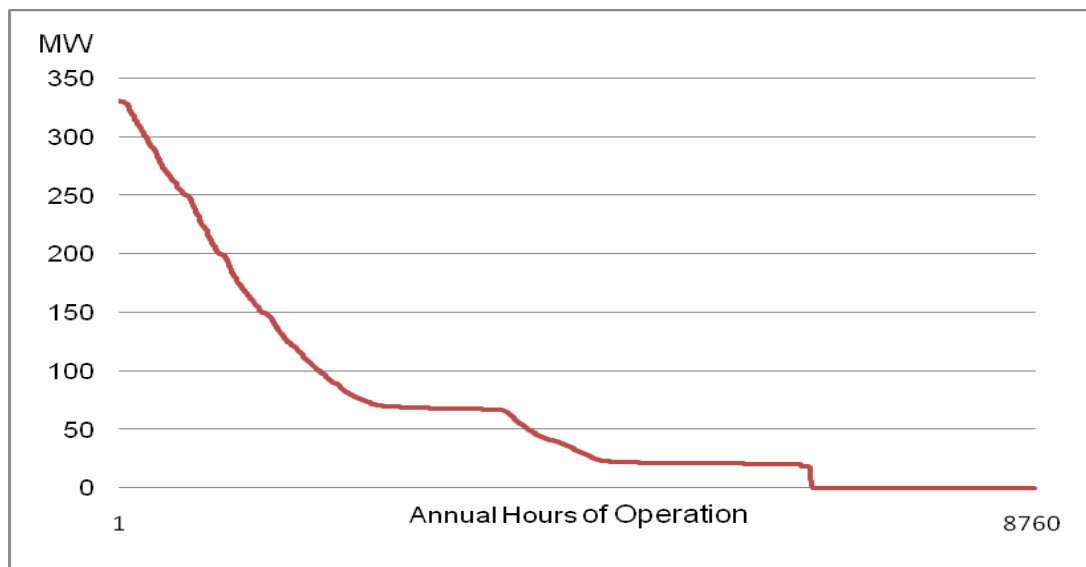
Of the remaining Encina units, only Encina 4 was dispatched with any regularity in 2008 (11 percent capacity factor), producing energy primarily during the summer. The remaining units were dispatched even less often. The scatter plots illustrating the dispatch of each of these units can be found in **Figure B-1**.

Figure 29: Encina 5 Hourly Operation (2008)



Source: EPA Continuous Emissions Monitoring Survey data.

Figure 30: Encina 5 Load Duration Curve (2008)



Source: Energy Commission Electricity Analysis Office

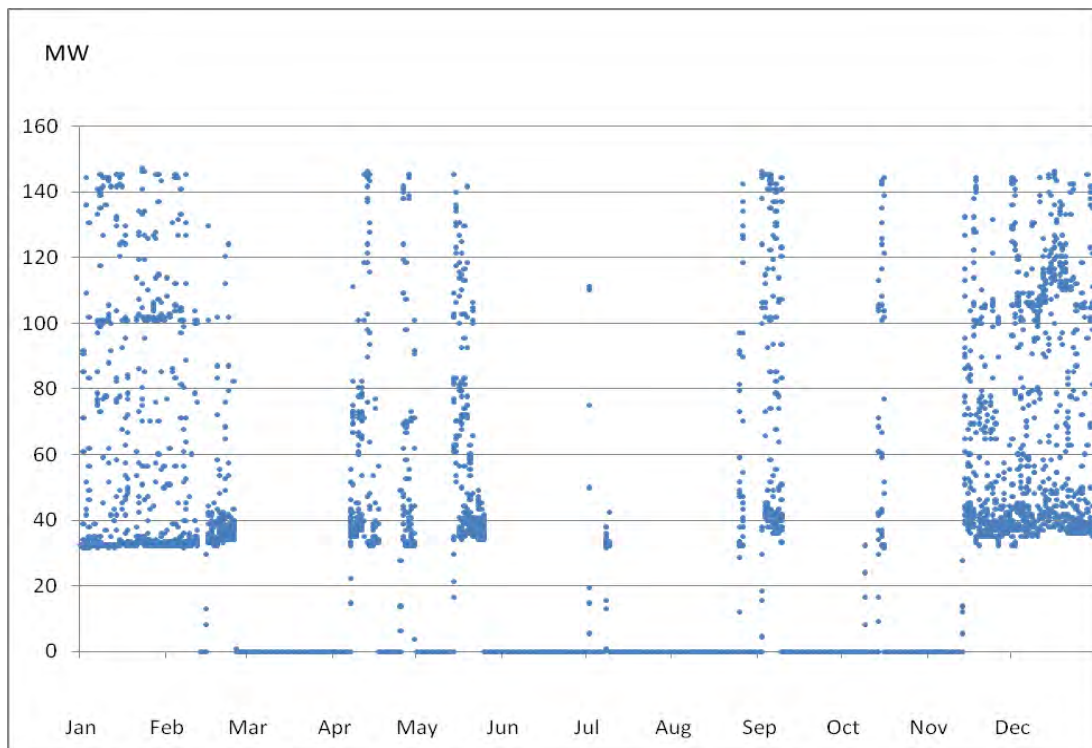
South Bay 3 (210 MW) operated in a fashion similar to Encina 5, being dispatched to minimum load year-round, ramping up to higher levels of output when necessary. The scatter plot illustrating the operation of South Bay 3 is presented in **Figure B-1**.

The remaining units at South Bay were dispatched primarily during non-summer months in 2008, notably during the last quarter of the year. Much of this dispatch coincided with periods during which South Bay 3 was unavailable. **Figure 31** illustrates the dispatch of South Bay 1; the profiles for South Bay 2 and 4 were similar.

An agreement has been reached to retire the South Bay facility as soon as it is no longer needed for local reliability. With the operation of the Otay Mesa facility (510 MW) as of 2009, Units 3 and 4 at South Bay will no longer be needed for local reliability. The remaining units will cease being needed when the Sunrise Power Link is energized, currently expected in 2012 or 2013. Retirement of the Encina facility would require at least an equal amount of replacement capacity in the LRA.²⁷ The owners of the facility have proposed the Carlsbad Energy Center on the site of the existing facility, a 558-MW combined-cycle that would replace Units 1–3, and have submitted an Application for Certification to the Energy Commission. A ruling on the application is expected later this year.

The SWRCB has proposed to eliminate OTC by December 2012 for South Bay and December 2017 for Encina.

Figure 31: South Bay 1 Hourly Operation (2008)



Source: EPA Continuous Emissions Monitoring Survey data.

²⁷ The California ISO plans a study in 2010 of the capacity and/or transmission upgrades needed to allow for the retirement of Encina.

Gas-Fired OTC Plants Not in Local Reliability Areas

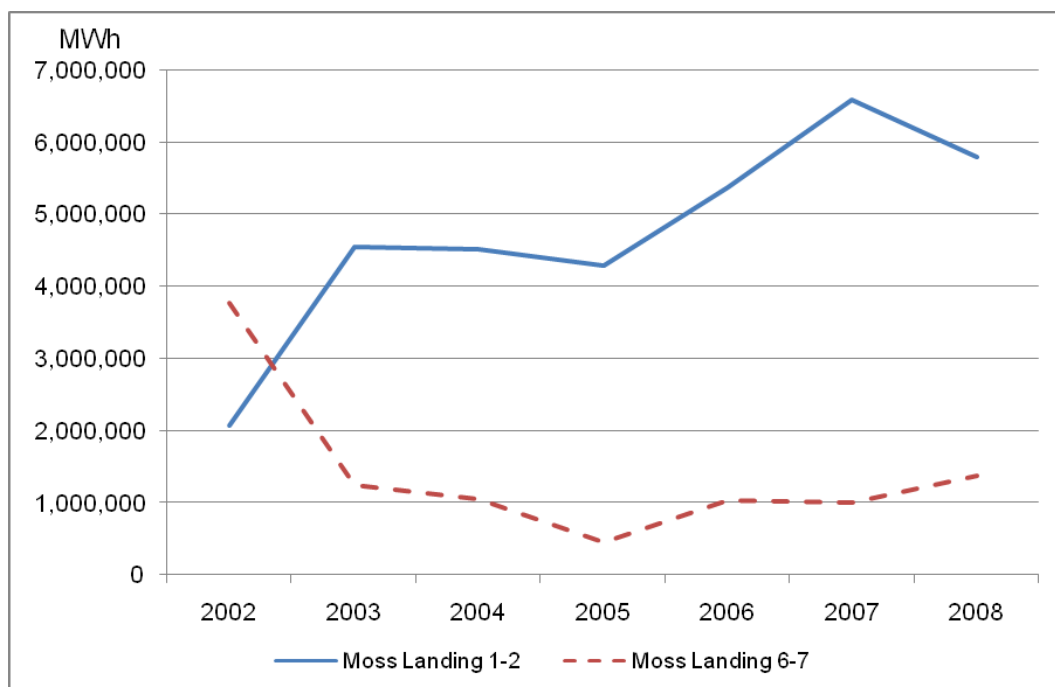
There are two gas-fired OTC plants that are not located in an LRA:

- Morro Bay 3 and 4 (300 MW each)
- Moss Landing 6 and 7 (702 MW each)
- Moss Landing combined-cycle 1 and 2 (540 MW each)

Moss Landing combined-cycle Units 1 and 2 came on-line in 2002, are thermally efficient and thus operate at high capacity factors, reaching 61 percent in 2008. Units 6 and 7 (702 MW each) were constructed in 1967 and 1968, respectively, and are used only as necessary. **Figure 32** illustrates the decline in use of the aging Units 6 and 7 at Moss Landing over 2002–2008, from 31 percent to 11 percent, as well as the year-over-year operation of the new combined-cycle units.

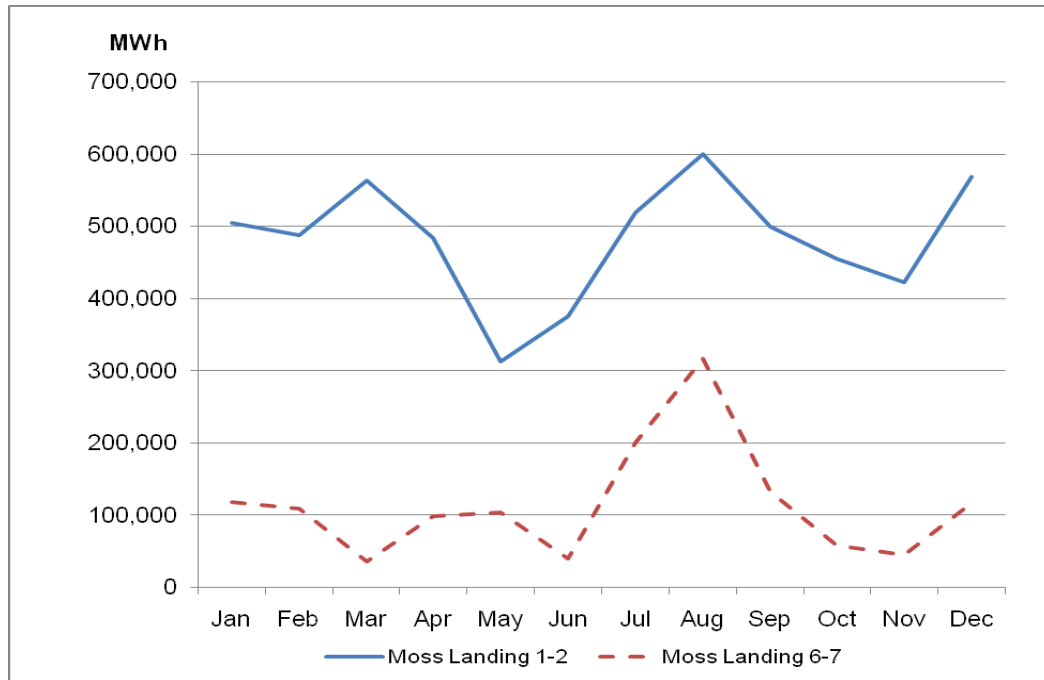
As is the case with most merchant facilities, both the new and aging units at Moss Landing are used more intensively during the summer, albeit at significantly different capacity factors. The newer units (1 and 2) operated at a 75 percent capacity factor in August 2008; the corresponding value for the aging units (6 and 7) was 30 percent. This is demonstrated by **Figure 33**.

Figure 32: Moss Landing 1-2 and 6-7 Annual Generation and Starting/Ending Capacity Factors (2002-2008)



Source: Energy Commission Electricity Analysis Office

Figure 33: Moss Landing 1-2 and 6-7 Monthly Generation and Peak Capacity Factors (2008)

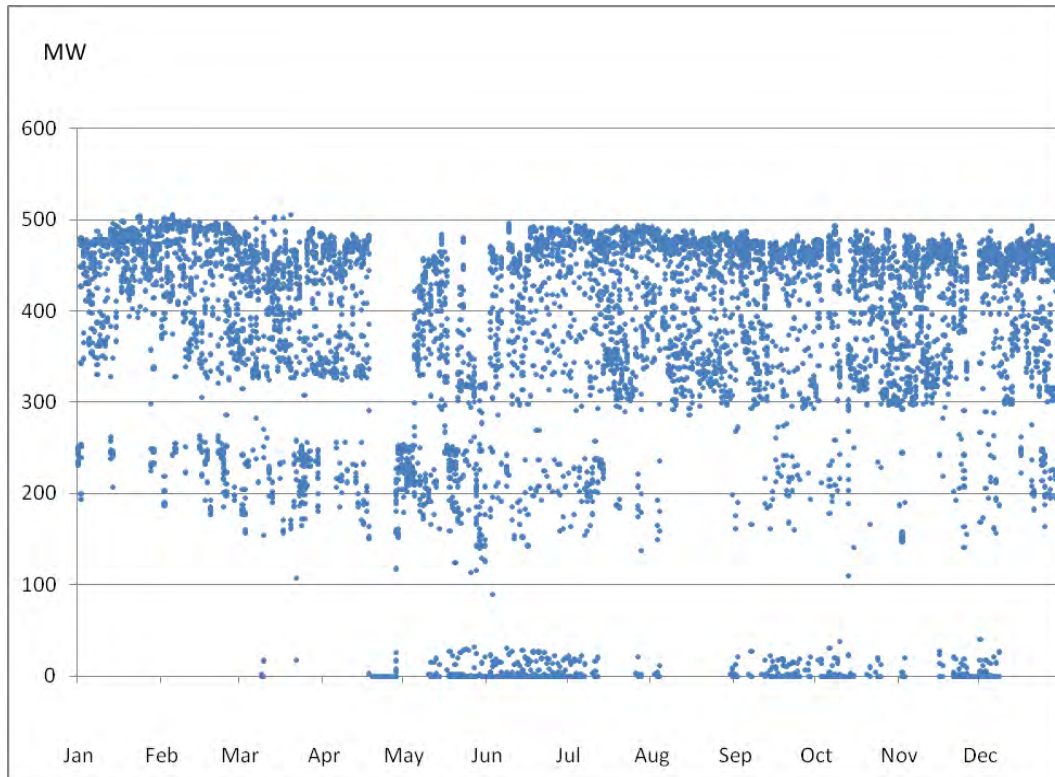


Source: Energy Commission Electricity Analysis Office

The intensive nature of Moss Landing 1's operation can be seen in **Figure 34**. The corresponding figure for Moss Landing 2 as found in **Figure B-1** is similar.

The operation of the new combined-cycles at Moss Landing is in contrast to the limited dispatch of the older units at Moss Landing. Scatter plots illustrating the dispatch of Moss Landing 6 and 7 are presented in **Figure B-1**; in 2008, they had 9 and 13 percent capacity factors, respectively. As the older units at Moss Landing are both inefficient and not needed for local reliability, they are only dispatched when other units are unavailable, or they are needed to meet high loads during the summer.

Figure 34: Moss Landing 1 Hourly Operation (2008)



Source: EPA Continuous Emissions Monitoring Survey data.

Figure 35 illustrates the reduced use of Morro Bay Units 3 and 4. Not needed for local reliability and displaced by newer facilities built during the past six years, they are dispatched only a handful of days a year. The periods during which they were dispatched in 2008 can be seen in scatter plots in **Figure B-1**.

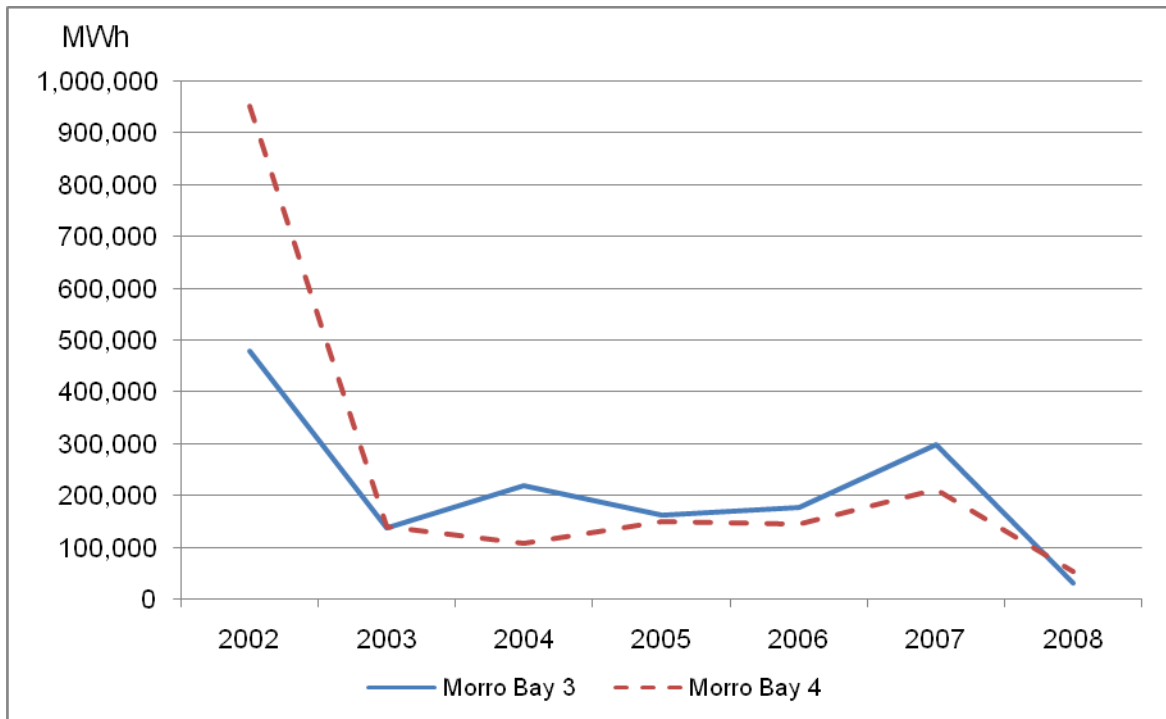
As the aging units at Moss Landing and Morro Bay do not contribute to local capacity requirements in an LRA, their retirement would require only that remaining capacity in Northern California be sufficient to meet zonal resource adequacy (RA) requirements. At present, sufficient capacity exists to allow for the retirement of the units at Morro Bay without threatening reliability. The retirement of Moss Landing 6 and 7 would presently require replacement capacity to maintain adequate reserve margins in the northern half of the state.²⁸

The Morro Bay Modernization and Replacement Power Plant Project was under consideration for about 10 years. The Energy Commission issued a permit with certain

²⁸ Depending upon the location of new capacity in Northern California, the retirement of capacity at Moss Landing may have an effect on local capacity requirements within the Greater Bay Area LRA. A California ISO study of the infrastructure upgrades needed to retire capacity at Moss Landing is expected to be undertaken in the near future.

contingencies in 2004. According to Dynegy, the repower project will not be pursued, and the existing plant likely will not operate beyond 2015. The SWRCB has proposed an OTC policy compliance deadline of December 2015 for the plant. The deadline for Moss Landing is December 2017, but the newer units are eligible to apply to use alternative compliance mechanisms given their relatively low heat rates.

Figure 35: Morro Bay 3 and 4 Annual Generation and Capacity Factors (2002-2008)



Source: Energy Commission Electricity Analysis Office

Aging Power Plants That Do Not Use OTC

As **Figure 2** shows, aging plants that are not OTC facilities total 2,589 MW (about 4 percent of California's total generating capacity). These facilities include 7 plants with 23 individual units. The following lists the plants, units, and cumulative capacities are as follows:

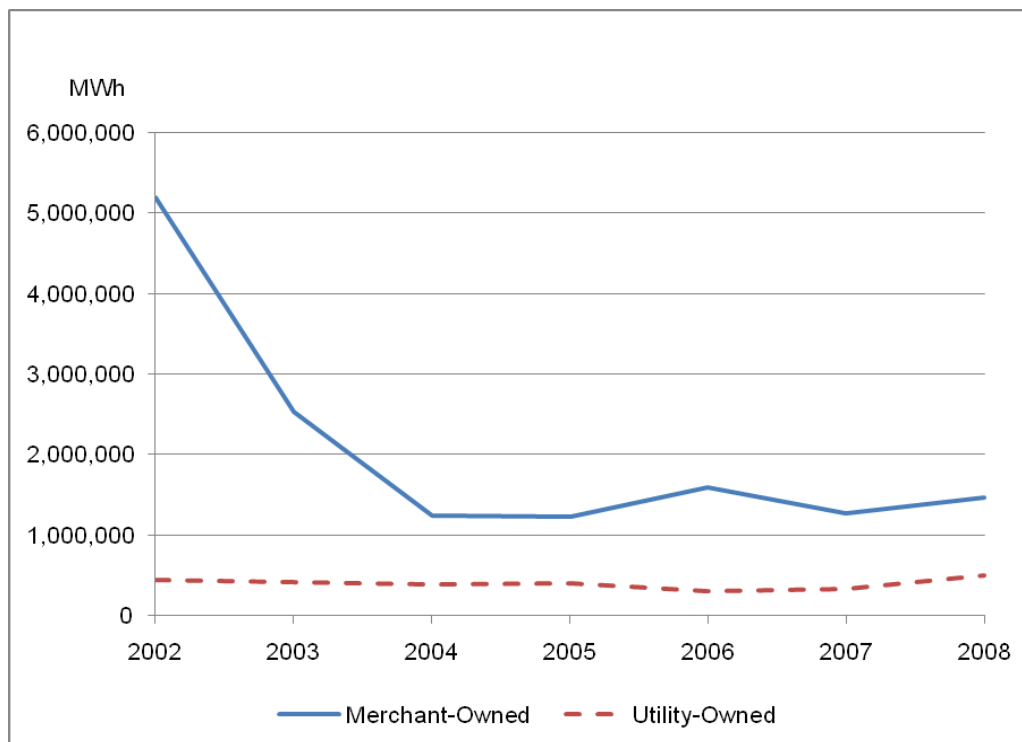
- Pittsburg 7 (682 MW)
- Broadway 3 (75 MW)
- Etiwanda Units 3 and 4 (666 MW)
- Grayson 3-5 and 8 (198 MW)
- Olive 1 and 2 (110 MW)

- Coolwater 1-4 (727 MW)
- El Centro 3 and 4 (132 MW)

Of these, 4 plants (12 units) are owned by utilities, while the other 3 plants (11 units) are merchant facilities. The merchant plants account for 2,075 MW, or 80 percent of the capacity of aging-only facilities. Two large merchant plants, Etiwanda (666 MW) and Coolwater (727 MW), account for two-thirds of the merchant capacity and generated 97 percent of the energy from all merchant APP facilities and 72 percent of the energy from all merchant and utility APP facilities combined in 2008. Pittsburg 7 (682 MW) is the remaining merchant aging-only unit.

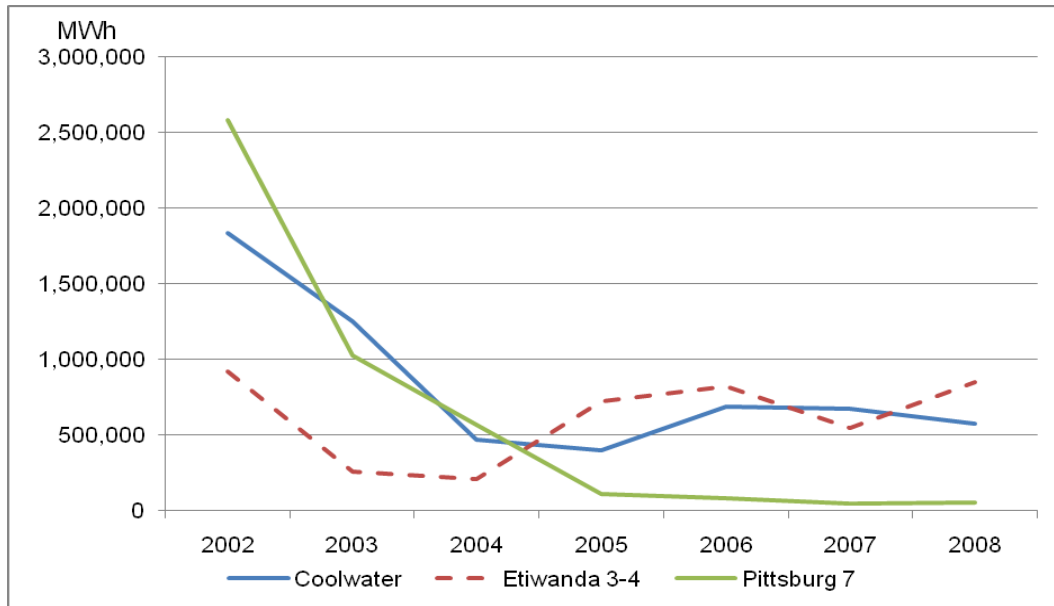
Figure 36 shows annual generation from merchant- and utility-owned APP facilities for 2002 through 2008. While the collective output of utility-owned facilities remained constant over 2002–2008, that of merchant facilities declined substantially. The merchant units were load-following units, which have been replaced by newer, more efficient generation. The utility-owned units, on the other hand, have long been used to meet summer peak loads. **Figure 37** indicates that a majority of the decline in generation from merchant APP plants over 2002–2008 came from reductions in output from units at two facilities: Coolwater 1–4 and Pittsburg 7.

Figure 36: Annual Generation From Merchant and Utility Aging Plants (2002–2008)



Source: Energy Commission Electricity Analysis Office

Figure 37: Annual Generation From Merchant Aging Plants (2002-2008)



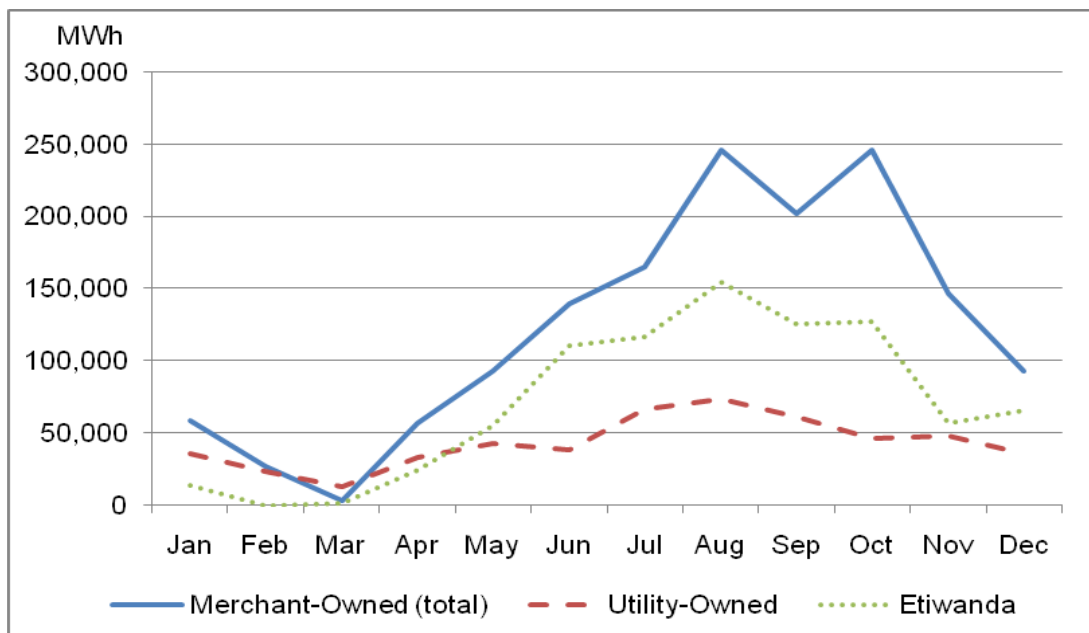
Source: Energy Commission Electricity Analysis Office

Figure 38 illustrates use of merchant- and utility-owned, aging-only facilities in 2008. Given their relative inefficiencies and higher operating expenses, aging units usually are not used as primary sources of energy on a daily basis but are called on during times of need, primarily in the summer. As noted above, the utility-owned APP included in this study are relatively inefficient units owned by municipal utilities with sufficient resources to meet their loads. As such, these units have consistently been run largely to meet peaking needs during the summer and have had correspondingly low capacity factors.

Of the seven aging-only facilities, Etiwanda, a merchant facility located in the California ISO-portion of the Los Angeles Basin, was the most frequently dispatched; Etiwanda 3 and 4 were operated at 12 and 17 percent capacity factors, respectively, in 2008. In total, the units produced energy equal to 15 percent of that produced by the LRA's OTC units. As can be seen from **Figure 39**, Etiwanda 4 is primarily operated at minimum set points of 30 and 70 MWs, ramping up to 320 MW as needed. The scatter plot for Etiwanda 3 is similar; it can be found in **Figure B-1**.

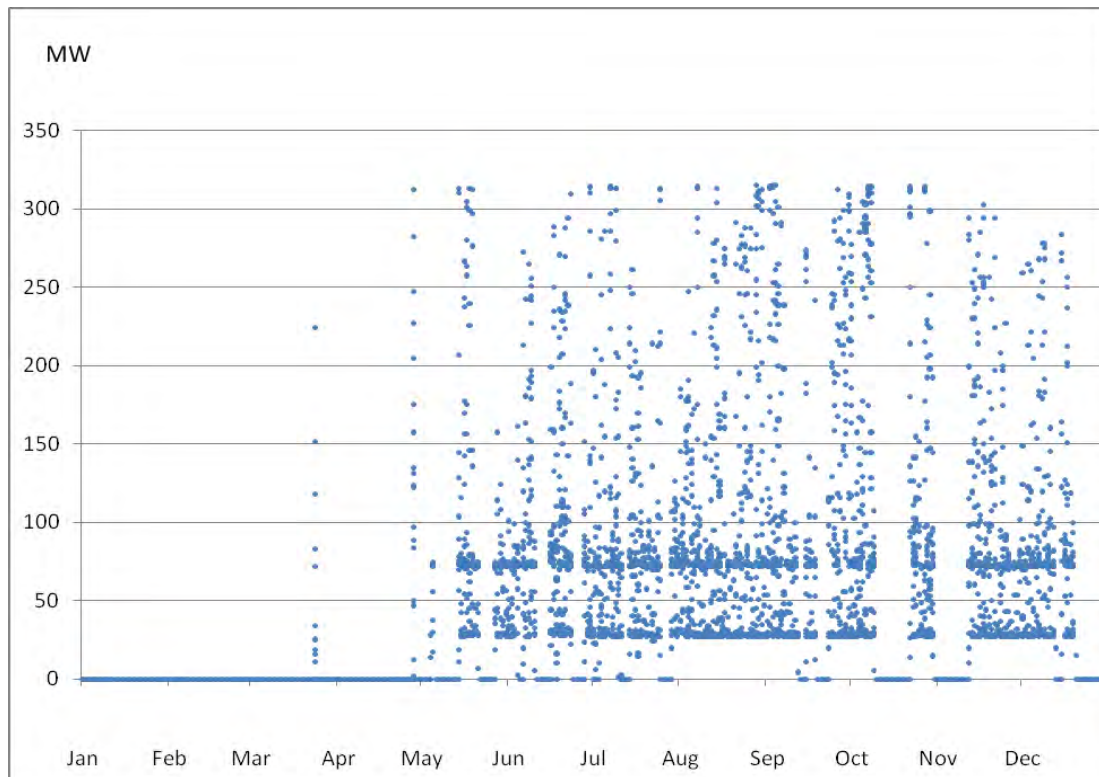
The other aging-only unit in the California ISO-portion of the Los Angeles Basin, Broadway 3, is owned by Pasadena Water and Power. **Figure 40** illustrates that this unit was used as needed to meet summer peak loads, ramping up from a minimum set point below 20 MW as needed from mid-June through mid-October.

Figure 38: Monthly Generation From Etiwanda, Total Merchant-, and Utility-Owned Aging Plants (2008)



Source: Energy Commission Electricity Analysis Office

Figure 39: Etiwanda 4 Hourly Operation (2008)

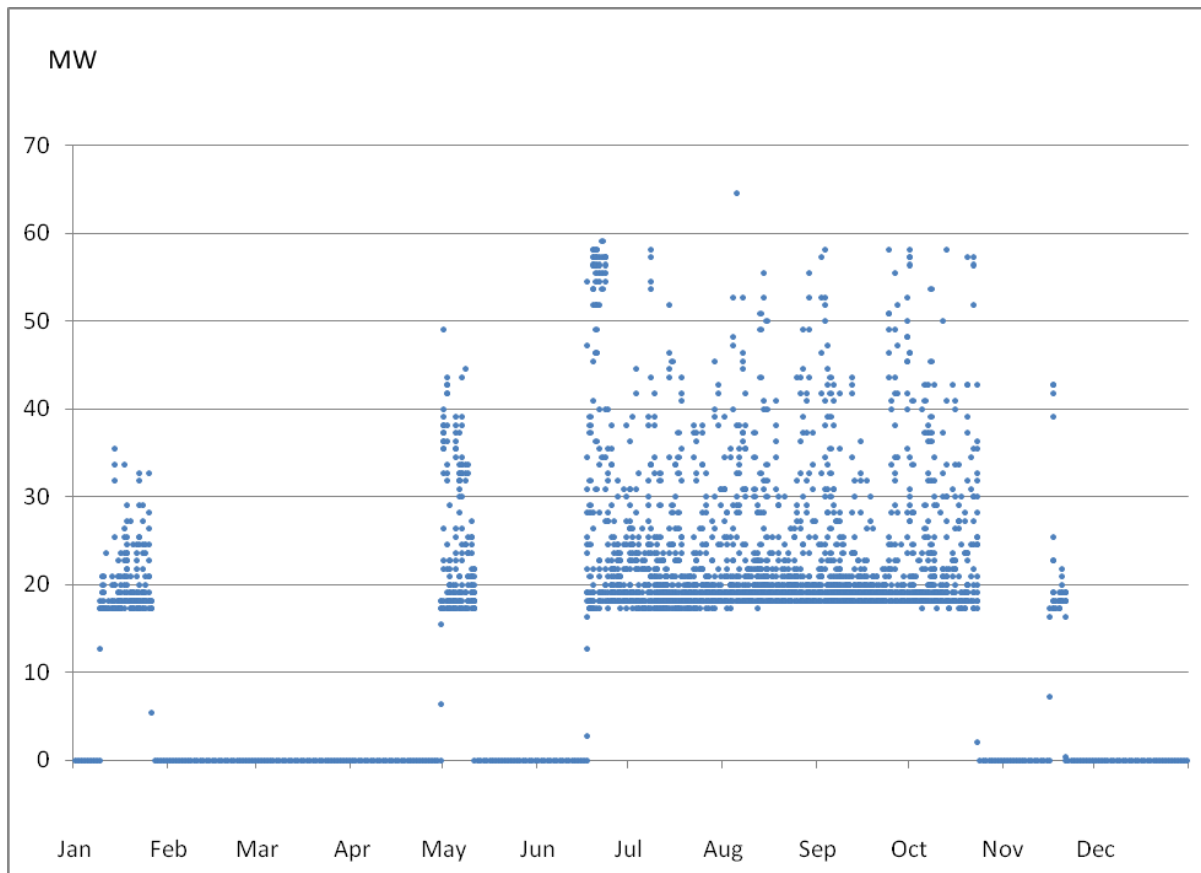


Source: EPA Continuous Emissions Monitoring Survey data.

The two aging-only facilities in the LADWP control area were operated differently in 2008. The scatter plots in **Figure B-1** indicate that the units at the Grayson facility (Glendale Water and Power, 238 MW total) were dispatched with some frequency, while Olive 1 and 2 (owned by Burbank Water and Power, 110 MW total) were dispatched only rarely. (Their 2 and 1 percent capacity factors, respectively, in 2008 were in keeping with prior years.)

Pittsburg 7 (682 MW), located in the Greater Bay Area LRA, was only dispatched for 5-day periods in May and July in 2008; it had a capacity factor of 1 percent for the third consecutive year.

Figure 40: Broadway 3 Hourly Operation (2008)

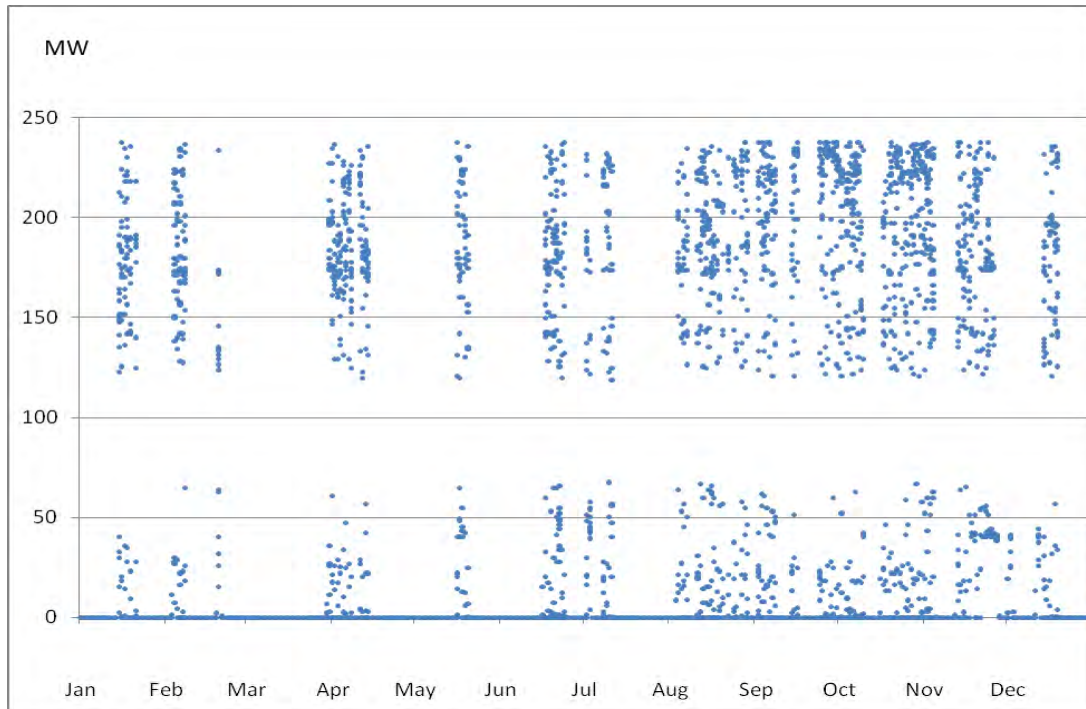


Source: EPA Continuous Emissions Monitoring Survey data.

Two aging-only plants are located outside LRAs. Two of the four units at the merchant Coolwater facility (Units 3 and 4, 290 MWs each) were dispatched with some frequency in 2008, with capacity factors of 9 and 13 percent, respectively; these values were consistent with their operation in recent years. **Figure 41** illustrates the dispatch of Unit 4; with an annual heat rate of 10,260 Btu/kWh and able to cycle off at night, it is relatively efficient—in comparison to other aging units—at providing load-following services. Units 1 and 2, in comparison, have heat rates of 12,800 Btu/kWh and higher and have been operated at capacity factors of 2 percent or less, as the scatter plots in **Figure B-1** will attest.

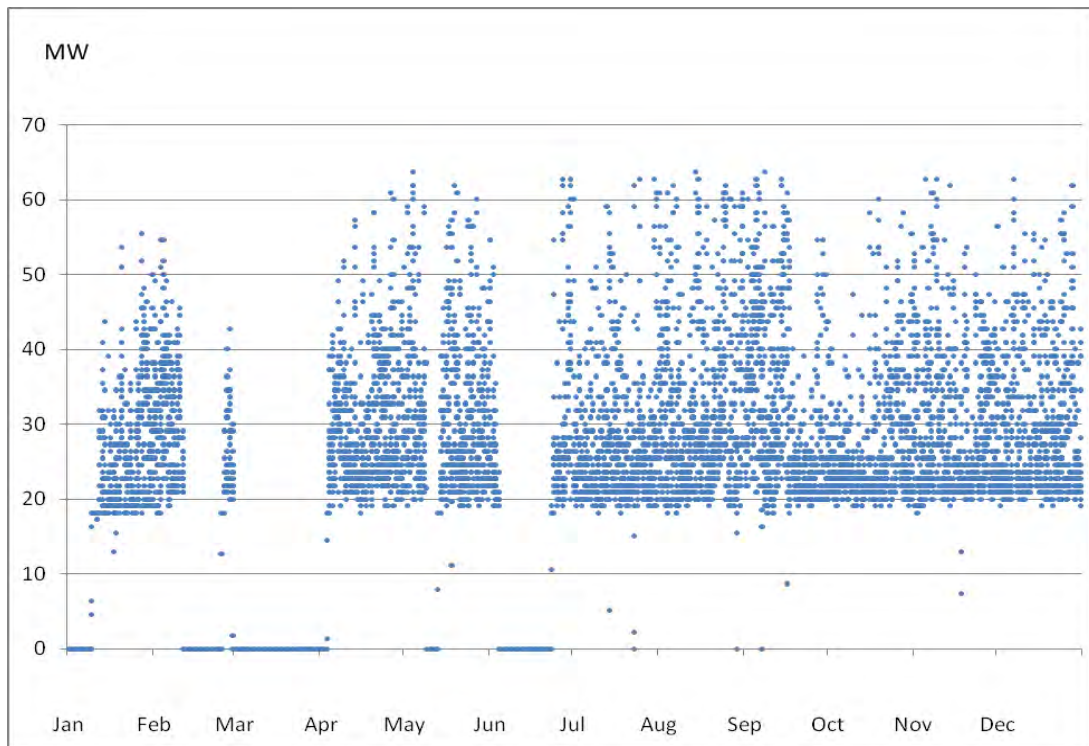
El Centro 3 and 4, operated by the Imperial Irrigation District (IID) are also outside an LRA. Unit 4 had a 28 percent capacity factor in 2008 and was dispatched year-round, frequently at or near its minimum set point of 20 MW (see **Figure 42**). Unit 3, in contrast, was operated only during the summer months, as can be seen from the scatter plot in **Figure B-1**. IID plans to repower Unit 3 in 2012.

Figure 41: Coolwater 4 Hourly Operation (2008)



Source: EPA Continuous Emissions Monitoring Survey data.

Figure 42: El Centro 4 Hourly Operation (2008)



Source: EPA Continuous Emissions Monitoring Survey data.

Glossary of Acronyms

Acronym	Definition
APP	Aging power plant
Btu	British thermal unit
CPUC	California Public Utilities Commission
IID	Imperial Irrigation District
ISO	Independent System Operator
<i>IEPR</i>	<i>Integrated Energy Policy Report</i>
IOU	Investor-owned utility
KWh	Kilowatt hour
LSE	Load-serving entity
LCR	Local capacity requirement
LRA	Local reliability area
LADWP	Los Angeles Department of Water & Power
MW	Megawatt
mmMWh	Million megawatt hour
OTC	Once-through cooling/Once-through cooled
RMR	Reliability must-run
RA	Resource Adequacy
SWRCB	State Water Resources Control Board

APPENDIX A: What Is Local Reliability?

Reliable electric service requires that sufficient generation capacity is available to meet peak demand—demand on the hottest day of the year when air conditioning use is highest—in the face of the sudden failure of a major system component. Assuming that sufficient capacity is constructed and brought on-line (the long-term planning component of reliability, also referred to as *resource adequacy* or *RA*), an adequate amount of capacity must be available to generate electricity within minutes. The latter is the day-to-day operating component of reliability.

Sufficient capacity must be available to meet the total demand on the system. As a rule, capacity equal to 115 to 117 percent of peak demand is needed to ensure that demand can be met during the peak hour. The surplus (referred to as the *reserve margin*) is needed to account for higher- than-average peak demand, the unavailability of resources due to maintenance needs, and protection against the sudden failure of a large power plant or transmission line. Because there are constraints on the ability to move energy over the transmission system, resource adequacy and operational reliability are issues across geographic areas smaller than the system level. For example, limits on the ability to move energy between the northern and southern zones of the California ISO control area create zonal reliability concerns. Similarly, constraints on the ability to move energy into the Los Angeles Basin and San Diego, create local reliability concerns that require threshold amounts of capacity be constructed and maintained in these areas (local resource adequacy or local capacity requirements, also known as LCR) and be available in real time as needed (local reliability needs). Within these local reliability areas (LRAs), there may be sub-area constraints that require, for example, specific power plants to be available.

The California ISO and LADWP determine the need for local capacity (planning need) within each of its LRAs, as well as how much capacity must be available to provide energy (operating requirement) in any given hour. They accomplish this by simulating the performance of the transmission system under expected demand conditions (annual peak demand for planning purposes, tomorrow's peak demand for operating assessments). The amount needed is primarily a function of the peak demand in the area and the amount or energy that can be imported into the area over the transmission system. The capacity requirement for each LRA may decline as transmission improvements relieve import constraints or increase proportionally as load grows. The California ISO anticipates that LRA boundaries will be fairly static over a three- to five-year time horizon and the minimum amount of capacity procured within each LRA should remain reasonably stable. Most LCR requirements trend upward by 1 to 2 percent per year based on load increases, but this is offset by transmission upgrades that allow additional energy to be imported.

How Is Local Reliability Maintained?

Many of the aging merchant OTC plants are inefficient and not able to profitably operate in energy markets; contractual agreements are required to ensure that these existing plants do not retire and are available when needed to guarantee local reliability.¹ Until 2006, the California ISO entered into one-year reliability must-run (RMR) contracts with merchant generators in transmission-constrained areas. These paid the generator both the going-forward capital costs needed to keep the unit in operable condition and the variable costs of starting up and producing requested energy in exchange for the California ISO's right to dispatch the unit when needed for local reliability. In January 2004, the CPUC-adopted RA requirements for all jurisdictional load-serving entities (LSEs) include investor-owned utilities, energy service providers, and community choice aggregators.² In June 2006, the CPUC adopted local RA requirements to address local reliability issues and ensure that LSEs have sufficient resources in transmission-constrained areas.³ RA contracts between generators and LSEs, which can exceed one year, largely replaced RMR contracts as the mechanism by which local reliability is assured. The latter remains a backstop in the event that the RA process does not yield a sufficient amount of local capacity under contract.

The California ISO periodically performs a local capacity technical analysis to determine the generation capacity (MW) required to address local reliability problems. This analysis shows the minimum generation capacity that must be available within each LRA, the geographical boundary and load within each LRA, as defined by transmission lines and substations that encompass the area, and the generating units within each LRA eligible to count toward meeting that area's LCR.

Each year, LSEs must submit a series of compliance filings to the CPUC. The September preliminary local RA filing demonstrates the local resources each LSE has under contract for the next year.⁴ The October final local RA filing demonstrates that the LSEs have met their local RA obligations in five defined transmission-constrained local areas (Big Creek/Ventura, Los Angeles Basin, San Diego, Greater Bay Area, and Other PG&E LRAs).

¹ Merchant plants are privately owned facilities that compete to sell energy and capacity to load serving entities. Municipal utilities, such as LADWP, own and control their facilities, so they are not faced with the possibility of premature retirements.

² D.04-01-050 at 10-51.

³ D.06-06-064.

⁴ Although RA resources provide the California ISO with almost all of the capacity needed to reliably operate the system, some local needs may not be resolved by RA resources alone, and the California ISO may designate RMR resources for local reliability requirements.

APPENDIX B: Historical Operations Data

Table B-1: 2009 Aging and Once-Through-Cooled Power Plants¹

Power Plant / Unit	Capacity (MW)	Heat Rate (Btu/kWh)	APP/OTC	Local Reliability Area	Year in Service	Ownership
Alamitos 1	175	17,290	Y/Y	LA	1956	AES
Alamitos 2	175	14,560	Y/Y	LA	1957	AES
Alamitos 3	326	10,780	Y/Y	LA	1961	AES
Alamitos 4	324	11,130	Y/Y	LA	1962	AES
Alamitos 5	485	10,270	Y/Y	LA	1964	AES
Alamitos 6	485	10,700	Y/Y	LA	1966	AES
Broadway 3	75	12,220	Y/N	LA	1965	Pasadena
Contra Costa 6	340	12,130	Y/Y	GBA	1964	Mirant
Contra Costa 7	340	11,060	Y/Y	GBA	1964	Mirant
Coolwater 1	65	13,860	Y/N	none	1961	Reliant
Coolwater 2	82	12,820	Y/N	none	1964	Reliant
Coolwater 3	290	10,820	Y/N	none	1978	Reliant
Coolwater 4	290	10,260	Y/N	none	1978	Reliant
Diablo Canyon 1	1,116	nuclear	N/Y	none	1984	PG&E
Diablo Canyon 2	1,116	nuclear	N/Y	none	1985	PG&E
El Centro 3	50	17,250	Y/N	none	1952	IID
El Centro 4	82	13,420	Y/N	none	1968	IID
El Segundo 3	335	10,580	Y/Y	LA	1964	NRG
El Segundo 4	335	11,140	Y/Y	LA	1965	NRG
Encina 1	107	12,690	Y/Y	SD	1954	NRG
Encina 2	104	14,390	Y/Y	SD	1956	NRG
Encina 3	110	11,600	Y/Y	SD	1958	NRG
Encina 4	300	12,720	Y/Y	SD	1973	NRG
Encina 5	330	12,160	Y/Y	SD	1978	NRG
Etiwanda 3	333	11,440	Y/N	LA	1963	Reliant
Etiwanda 4	333	12,330	Y/N	LA	1963	Reliant
Grayson 3	20	17,130	Y/N	LADWP	1953	Glendale
Grayson 4	44	13,920	Y/N	LADWP	1959	Glendale
Grayson 5	44	14,150	Y/N	LADWP	1969	Glendale
Grayson CC	130	16,880	Y/N	LADWP	1977	Glendale
Harbor CC	227	9,600	N/Y	LADWP	2001	LADWP
Haynes 1	230	11,260	Y/Y	LADWP	1962	LADWP
Haynes 2	230	10,390	Y/Y	LADWP	1963	LADWP
Haynes 5	343	10,540	Y/Y	LADWP	1967	LADWP
Haynes 6	243	11,410	Y/Y	LADWP	1967	LADWP

Power Plant / Unit	Capacity (MW)	Heat Rate (Btu/kWh)	APP/OTC	Local Reliability Area	Year in Service	Ownership
Haynes CC	560	7,090	N/Y	LADWP	2005	LADWP
Humboldt Bay 1	53	12,660	Y/Y	Humboldt	1956	PG&E
Humboldt Bay 2	54	13,070	Y/Y	Humboldt	1958	PG&E
Huntington Beach 1	215	11,160	Y/Y	LA	1958	AES
Huntington Beach 2	215	11,130	Y/Y	LA	1958	AES
Huntington Beach 3	225	10,530	N/Y	LA	2003	AES
Huntington Beach 4	225	10,690	N/Y	LA	2003	AES
Mandalay 1	218	9,610	Y/Y	BC/V	1959	Reliant
Mandalay 2	218	10,280	Y/Y	BC/V	1959	Reliant
Morro Bay 3	300	9,950	Y/Y	none	1962	Dynegy
Morro Bay 4	300	9,790	Y/Y	none	1963	Dynegy
Moss Landing 6	702	15,300	Y/Y	none	1967	Dynegy
Moss Landing 7	702	9,600	Y/Y	none	1968	Dynegy
Moss Landing 1	540	7,130	N/Y	none	2002	Dynegy
Moss Landing 2	540	7,130	N/Y	none	2002	Dynegy
Olive 1	50	14,240	Y/N	LADWP	1959	Burbank
Olive 2	60	23,750	Y/N	LADWP	1964	Burbank
Ormond Beach 1	806	11,330	Y/Y	BC/V	1971	Reliant
Ormond Beach 2	806	10,280	Y/Y	BC/V	1973	Reliant
Pittsburg 5	325	11,810	Y/Y	GBA	1960	Mirant
Pittsburg 6	325	11,650	Y/Y	GBA	1961	Mirant
Pittsburg 7	682	14,610	Y/N	GBA	1972	Mirant
Potrero 3	207	11,060	Y/Y	GBA	1965	Mirant
Redondo Beach 5	179	17,690	Y/Y	LA	1954	AES
Redondo Beach 6	175	22,280	Y/Y	LA	1957	AES
Redondo Beach 7	493	10,220	Y/Y	LA	1967	AES
Redondo Beach 8	496	10,910	Y/Y	LA	1967	AES
San Onofre 2	1,122	nuclear	N/Y	LA	1983	SCE/SDG&E
San Onofre 3	1,124	nuclear	N/Y	LA	1984	SCE/SDG&E
Scattergood 1	179	12,360	Y/Y	LADWP	1958	LADWP
Scattergood 2	179	11,920	Y/Y	LADWP	1959	LADWP
Scattergood 3	445	10,690	Y/Y	LADWP	1974	LADWP
South Bay 1	136	10,970	Y/Y	SD	1960	Dynegy
South Bay 2	136	11,050	Y/Y	SD	1962	Dynegy
South Bay 3	210	11,500	Y/Y	SD	1964	Dynegy
South Bay 4	214	12,570	Y/Y	SD	1971	Dynegy

1 Includes APP and OTC units outside of LRAs discussed in the text: BC/V= Big Creek/Ventura, GBA=Greater Bay Area, LA=LA Basin, LADWP=Los Angeles Department of Water and Power, SD=San Diego

Source: Energy Commission Electricity Analysis Office

**Table B-2: Aging and Once-Through-Cooled Power Plant
Annual Capacity Factor (Percent)**

Power Plant / Unit	2002	2003	2004	2005	2006	2007	2008
Alamitos 1	10	8	7	3	3	2	2
Alamitos 2	11	8	7	2	3	2	2
Alamitos 3	35	37	24	9	17	18	23
Alamitos 4	24	21	19	5	8	9	18
Alamitos 5	34	20	25	9	9	9	21
Alamitos 6	19	18	11	10	11	7	11
Broadway 3	0	0	0	7	3	2	14
Contra Costa 6	28	2	4	1	1	1	2
Contra Costa 7	37	16	22	10	4	3	3
Coolwater 1	14	3	1	3	4	1	0
Coolwater 2	14	4	1	2	4	1	1
Coolwater 3	35	27	8	6	11	11	9
Coolwater 4	30	20	10	8	15	15	13
Diablo Canyon 1	72	98	74	85	102	91	100
Diablo Canyon 2	95	79	82	97	87	99	74
El Centro 3	10	13	5	16	14	8	8
El Centro 4	24	26	23	11	8	17	28
El Segundo 3	35	24	9	12	12	10	3
El Segundo 4	46	20	8	10	9	9	14
Encina 1	15	12	18	16	5	6	1
Encina 2	19	16	24	17	10	4	4
Encina 3	19	21	34	19	12	8	7
Encina 4	33	34	44	31	18	8	11
Encina 5	34	38	43	20	19	11	21
Etiwanda 3	18	5	2	14	16	11	17
Etiwanda 4	8	4	6	11	12	8	12
Grayson 3	0	1	6	3	0	15	1
Grayson 4	6	13	18	26	12	4	19
Grayson 5	36	19	14	11	25	27	19
Grayson CC	1	3	3	3	2	3	2
Harbor CC	0	19	12	10	7	6	8
Haynes 1	22	30	30	22	12	26	23
Haynes 2	28	22	30	18	22	20	20
Haynes 5	15	33	11	16	10	4	20
Haynes 6	19	10	12	3	5	15	4
Haynes CC	0	0	0	57	60	63	70

Power Plant / Unit	2002	2003	2004	2005	2006	2007	2008
Humboldt Bay 1	40	27	39	47	46	51	55
Humboldt Bay 2	39	19	38	45	46	48	53
Huntington Beach 1	32	37	38	26	20	23	28
Huntington Beach 2	37	37	41	22	17	7	20
Huntington Beach 3	N/A	8	19	19	12	27	17
Huntington Beach 4	N/A	9	17	14	11	13	14
Mandalay 1	25	14	15	7	8	7	12
Mandalay 2	28	18	20	11	10	11	19
Morro Bay 3	18	5	8	6	7	12	1
Morro Bay 4	36	5	4	6	6	8	2
Moss Landing 6	36	9	6	4	6	6	9
Moss Landing 7	27	12	12	4	11	10	13
Moss Landing 1	30	60	50	50	57	67	64
Moss Landing 2	26	54	59	53	57	71	58
Olive 1	14	6	3	8	1	0	2
Olive 2	0	0	6	0	1	0	1
Ormond Beach 1	16	10	19	2	0	5	4
Ormond Beach 2	17	15	13	6	6	9	7
Pittsburg 5	19	26	23	12	7	3	2
Pittsburg 6	24	7	20	7	5	3	2
Pittsburg 7	43	17	9	2	1	1	1
Potrero 3	30	45	46	21	29	26	29
Redondo Beach 5	22	8	11	3	6	5	2
Redondo Beach 6	5	8	2	1	2	2	1
Redondo Beach 7	3	2	1	1	2	2	2
Redondo Beach 8	22	12	17	6	7	7	4
San Onofre 2	86	99	82	91	69	84	90
San Onofre 3	97	87	71	96	69	89	66
Scattergood 1	27	27	29	10	18	16	28
Scattergood 2	31	28	28	29	18	25	14
Scattergood 3	6	34	22	12	24	20	17
South Bay 1	36	34	43	46	32	14	18
South Bay 2	37	39	51	36	30	15	16
South Bay 3	16	22	30	24	7	13	22
South Bay 4	4	2	12	7	5	8	11

Source: Haynes and Scattergood unit generation 2002-2007 is based on EIA Continuous Emissions Monitoring Survey data. Unit generation data for other units is from Energy Commission Quarterly Fuel and Energy Report filings.

Table B-3: Aging and Once-Through-Cooled Power Plant Annual Generation (GWh)¹

Power Plant / Unit	2002	2003	2004	2005	2006	2007	2008
Alamitos 1	145,384	124,706	99,975	41,526	50,032	24,803	33,908
Alamitos 2	169,842	130,173	105,647	32,665	41,327	32,343	23,100
Alamitos 3	1,000,506	1,046,905	675,929	260,716	487,623	505,217	649,444
Alamitos 4	669,664	591,286	543,098	155,027	225,536	263,056	500,022
Alamitos 5	1,431,646	858,710	1,070,064	393,998	393,097	362,016	873,876
Alamitos 6	798,059	782,660	459,661	427,180	479,110	299,146	452,396
Broadway 3	0	0	0	46,907	22,192	12,982	89,899
Contra Costa 6	848,194	57,505	122,342	36,005	26,528	42,599	57,423
Contra Costa 7	1,103,846	485,195	643,428	297,355	115,183	98,346	102,133
Coolwater 1	80,893	16,006	8,215	16,809	20,525	5,081	1,740
Coolwater 2	101,645	26,943	10,398	13,130	25,193	8,716	3,826
Coolwater 3	893,767	687,156	206,107	157,287	275,036	277,479	232,328
Coolwater 4	757,870	518,560	244,042	209,974	368,627	383,971	338,330
Diablo Canyon 1	7,020,202	9,585,431	7,208,257	8,313,575	9,944,983	8,866,080	9,838,642
Diablo Canyon 2	9,285,006	7,699,608	8,001,944	9,441,727	8,520,000	9,722,380	7,251,884
El Centro 3	43,691	58,184	23,958	71,833	59,511	36,697	35,993
El Centro 4	168,301	187,019	166,234	81,161	58,760	120,042	201,588
El Segundo 3	1,035,943	696,180	258,510	366,353	339,515	283,874	87,211
El Segundo 4	1,338,198	578,943	228,547	297,908	277,742	263,289	420,550
Encina 1	139,554	114,506	169,757	146,205	42,911	56,352	7,134
Encina 2	176,549	141,348	216,139	157,440	87,071	39,951	32,053
Encina 3	181,019	203,478	329,607	179,890	111,523	78,834	65,181
Encina 4	869,626	886,183	1,153,198	806,465	470,393	201,799	288,918
Encina 5	985,062	1,095,215	1,237,406	575,978	541,681	327,019	603,725
Etiwanda 3	527,098	145,643	44,798	399,801	475,555	326,587	510,192

Power Plant / Unit	2002	2003	2004	2005	2006	2007	2008
Etiwanda 4	245,823	113,670	168,023	325,451	346,671	225,762	338,249
Grayson 3	0	2,382	10,318	6,015	509	25,523	2,0772
Grayson 4	22,489	48,834	69,121	99,719	46,494	16,239	73,727
Grayson 5	139,587	73,309	55,176	41,490	96,400	103,506	73,9422
Grayson CC	13,536	36,353	30,541	33,478	20,522	33,493	27,297
Harbor CC		496,052	300,721	267,526	180,326	151,081	203,034
Haynes 1	428,601	583,965	577,092	421,068	231,023	506,638	469,350
Haynes 2	547,265	421,594	585,946	352,829	431,889	379,330	395,654
Haynes 5	459,319	997,081	331,237	490,128	287,700	109,986	589,548
Haynes 6	552,765	307,336	358,923	79,039	137,064	460,400	74,735
Haynes CC			1,863	2,279,771	2,377,262	2,506,372	3,423,312
Humboldt Bay 1	184,332	124,366	179,741	216,451	214,673	237,059	254,258
Humboldt Bay 2	183,478	88,236	181,674	212,662	215,772	228,743	252,836
Huntington Beach 1	593,836	687,507	726,128	489,439	384,361	426,805	530,662
Huntington Beach 2	704,718	692,315	767,623	415,798	314,227	135,173	385,015
Huntington Beach 3	0	160,724	368,439	379,713	229,597	528,767	334,154
Huntington Beach 4	0	175,356	344,740	269,646	212,553	252,048	285,987
Mandalay 1	474,274	268,375	291,888	137,567	160,750	130,903	229,242
Mandalay 2	531,217	341,282	378,187	211,460	185,531	207,293	367,463
Morro Bay 3	477,710	140,106	223,373	166,175	178,531	305,763	30,905
Morro Bay 4	952,001	139,114	108,775	153,085	145,994	215,005	52,481
Moss Landing 6	2,223,839	554,528	344,032	235,205	380,210	366,073	579,749
Moss Landing 7	1,664,460	724,555	736,306	231,933	663,004	631,956	795,586
Moss Landing 1	1,403,695	2,839,092	2,376,068	2,365,094	2,682,447	3,183,622	3,036,669
Moss Landing 2	1,230,641	2,536,060	2,787,905	2,518,509	2,679,697	3,341,593	2,754,037
Olive 1	60,910	26,328	13,178	33,031	4,035	2,122	7,676

Power Plant / Unit	2002	2003	2004	2005	2006	2007	2008
Olive 2			31,352	1,419	3,379	0	3,724
Ormond Beach 1	1,161,114	737,821	1,313,299	133,615	15,939	361,417	278,963
Ormond Beach 2	1,175,626	1,081,400	935,344	391,101	456,997	656,665	504,098
Pittsburg 5	543,207	740,839	657,632	341,666	211,384	73,218	63,918
Pittsburg 6	681,269	197,881	578,967	202,408	147,870	72,942	66,651
Pittsburg 7	2,581,405	1,026,447	566,225	108,788	82,728	44,869	49,003
Potrero 3	544,528	824,960	844,596	385,621	521,444	474,719	530,220
Redondo Beach 5	975,607	360,689	467,634	114,197	242,145	198,446	86,274
Redondo Beach 6	83,270	126,838	35,915	14,631	26,960	24,740	15,125
Redondo Beach 7	47,314	25,810	22,599	17,250	26,225	24,709	25,247
Redondo Beach 8	960,270	529,386	736,394	278,134	287,648	283,105	190,014
San Onofre 2	8,499,969	9,712,482	8,054,877	8,931,731	6,753,997	8,298,429	8,856,815
San Onofre 3	9,548,152	8,596,269	6,976,282	9,468,279	6,816,843	8,805,572	6,535,010
Scattergood 1	417,082	417,752	448,173	154,551	278,374	254,650	447,305
Scattergood 2	485,002	444,524	433,878	454,995	279,346	391,875	223,560
Scattergood 3	244,085	1,327,568	843,113	455,475	935,603	767,928	656,301
South Bay 1	423,016	406,292	519,153	546,285	387,083	166,726	210,958
South Bay 2	444,848	466,938	611,512	427,043	353,689	178,710	187,651
South Bay 3	298,819	409,023	548,004	434,765	128,967	240,810	400,468
South Bay 4	77,007	46,489	234,612	125,877	89,415	149,954	216,165

¹ A blank space indicates no data reported. A zero indicates no generation occurred.

² Values are not consistent with Continuous Emission Monitoring Survey data used to compile scatter plots in **Figure B-1**.

Source: Quarterly Fuel and Energy Report (QFER) Filings

Table B-4: Aging and Once-Through-Cooled Power Plant Monthly Generation (2008 MWh)

Power Plant / Unit	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Alamitos 1	0	0	0	0	3,296	7,037	1,539	4,345	12,059	5,632	0	0
Alamitos 2	0	0	0	0	1,697	7,183	3,086	1,920	5,184	1,835	0	2,195
Alamitos 3	0	0	19,708	33,774	59,807	68,674	85,406	104,000	91,318	96,609	73,884	16,264
Alamitos 4	82,821	9,404	0	11,769	22,510	71,178	52,791	43,440	52,214	72,532	50,471	30,892
Alamitos 5	0	0	0	0	50,136	58,643	100,936	121,446	117,024	121,693	173,766	130,232
Alamitos 6	0	0	0	0	14,130	59,576	7,015	151,637	33,620	76,566	106,137	3,715
Broadway 3	8,465	0	0	115	6,734	9,614	16,610	17,061	16,365	12,748	2,187	0
Contra Costa 6	0	0	6,514	1,494	6,396	3,690	6,706	9,905	5,389	802	-194	16,721
Contra Costa 7	0	878	0	3,458	9,112	0	13,934	34,605	12,645	4,400	810	22,291
Coolwater 1	0	0	0	0	1,740	0	0	0	0	0	0	0
Coolwater 2	0	0	0	0	2,270	0	0	1,556	0	0	0	0
Coolwater 3	30,484	12,520	0	0	0	12,389	6,218	41,106	29,629	48,092	42,943	8,947
Coolwater 4	15,247	15,728	2,718	33,450	10,477	17,116	11,748	48,683	46,770	70,551	47,631	18,211
Diablo Canyon 1	829,773	788,126	843,116	812,093	792,870	816,888	841,323	840,916	809,462	816,790	809,953	837,332
Diablo Canyon 2	826,741	41,777	-2,903	449,048	845,735	815,407	840,889	418,326	639,595	736,072	806,165	835,032
El Centro 3	0	0	0	0	824	7,672	10,892	10,980	5,625	0	0	0
El Centro 4	13,260	10,480	0	19,857	20,130	7,736	20,291	24,086	22,378	19,829	21,418	22,123
El Segundo 3	0	1,059	3,644	8,088	17,727	17,034	31,422	3,558	4,679	0	0	0
El Segundo 4	18,569	13,752	1,255	5,365	19,265	31,882	51,634	54,884	54,340	147,023	10,534	12,047
Encina 1	0	0	0	712	0	0	652	0	0	3,757	0	2,013
Encina 2	0	0	0	0	0	0	745	0	5,164	5,357	7,261	13,526
Encina 3	18,603	0	0	1,542	5,877	0	540	839	4,153	7,560	4,605	21,462
Encina 4	0	21,817	0	21,997	1,864	36,971	25,471	51,468	59,396	24,288	10,716	34,930
Encina 5	42,096	6,006	10,933	61,654	36,447	51,936	34,768	57,768	81,083	87,000	65,859	68,175
Etiwanda 3	14,169	-433	648	21,973	30,544	71,522	70,748	91,906	73,359	81,477	19,685	34,594

Power Plant / Unit	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Etiwanda 4	-564	-387	181	2,105	24,116	38,682	45,575	62,676	52,408	45,806	36,461	31,190
Grayson 3	358	237	0	0	849	350	31	103	0	0	149	0
Grayson 4	1,960	7,360	11,446	10,800	4,516	8,681	7,850	3,385	8,331	0	6,003	3,395
Grayson 5	9,891	4,364	0	0	8,467	3,857	4,617	10,800	2,876	12,717	7,128	9,225
Grayson CC	1,861	477	1,074	1,192	1,337	130	3,537	5,777	5,225	1,182	4,604	901
Harbor CC	4,908	15,403	307	16,165	23,766	27,239	14,844	26,984	17,108	9,393	29,417	17,500
Haynes 1	17,638	67,471	50,041	41,552	33,591	55,260	-3	50,532	4,539	21,345	64,687	62,697
Haynes 2	58,036	-220	-149	62,350	10,611	29,822	59,312	44,736	58,307	30,856	24,560	17,433
Haynes 5	-705	-607	51,941	62,350	12,256	18,498	68,712	55,401	126,232	36,174	40,515	118,781
Haynes 6	-705	-607	-790	-750	-1,005	-1,105	29,729	49,968	0	0	0	0
Haynes Unit CC	366,187	344,265	310,908	346,246	339,091	284,710	346,312	351,667	319,645	281,398	133,318	-435
Humboldt Bay 1	26,040	24,385	18,435	8,397	22,834	21,045	22,105	19,379	26,711	20,318	24,703	19,906
Humboldt Bay 2	25,434	25,662	29,959	29,553	21,327	20,197	17,053	17,285	5,061	19,661	15,658	25,986
Huntington Beach 1	64,843	38,302	33,246	31,730	41,339	52,582	49,361	62,932	58,803	68,498	2,564	26,462
Huntington Beach 2	57,937	31,536	16,010	1,052	13,114	56,450	41,405	55,186	23,459	51,520	14,463	22,883
Huntington Beach 3	18,847	0	0	71,763	12,949	8,221	29,779	54,713	47,161	28,315	55,490	6,916
Huntington Beach 4	0	0	0	2,922	37,700	34,028	45,753	11,889	54,153	61,553	30,442	7,547
Mandalay 1	13,878	-332	1,423	-230	7,285	18,896	22,353	33,901	33,514	49,320	38,089	11,145
Mandalay 2	30,017	10,275	8,992	29,156	18,511	25,580	37,785	50,160	38,234	57,132	45,638	15,983
Morro Bay 3	5,756	0	0	1,041	0	3,564	9,889	7,005	1,265	2,385	0	0
Morro Bay 4	5,600	0	0	0	0	9,397	7,653	29,831	0	0	0	0
Moss Landing 6	40,417	46,800	35,802	61,701	51,745	0	32,512	135,884	47,736	42,773	39,313	45,066
Moss Landing 7	77,791	62,679	0	36,634	51,617	39,951	168,460	180,925	85,064	15,738	5,128	71,599
Moss Landing 1	332,847	297,262	274,567	189,287	195,494	181,346	271,346	307,071	251,283	233,576	219,703	282,887
Moss Landing 2	171,239	190,733	288,457	294,851	117,413	194,007	246,921	292,636	248,261	222,036	202,504	284,979
Olive 1	0	0	0	1,065	0	0	116	1,352	0	0	5,143	0

Power Plant / Unit	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Olive 2	0	0	0	0	0	0	2,883	0	0	0	841	0
Ormond Beach 1	20,038	0	22,907	16,061	0	28,188	22,817	71,772	48,734	12,682	31,177	4,587
Ormond Beach 2	0	1,309	9,033	28,548	20,093	47,415	60,920	158,823	65,182	55,594	16,009	41,172
Pittsburg 5	0	0	6,812	2,344	18,544	0	16,950	10,020	9,248	0	0	0
Pittsburg 6	0	0	10,811	2,635	7,606	5,057	13,306	10,797	5,967	2,625	0	7,847
Pittsburg 7	-507	-476	-463	-759	23,620	-456	30,514	-479	-479	-496	-461	-555
Potrero 3	46,409	49,643	12,217	-270	33,748	41,522	48,745	59,881	57,913	59,151	56,516	64,745
Redondo Beach 5	0	0	2,127	0	12,572	0	23,113	0	26,634	21,828	0	0
Redondo Beach 6	0	0	396	0	370	3,168	2,959	2,340	4,930	962	0	0
Redondo Beach 7	0	0	838	0	1,890	4,453	4,507	6,751	6,583	0	225	0
Redondo Beach 8	0	0	0	0	34,114	0	0	17,802	0	0	138,098	0
San Onofre 2	53,994	17,550	24,766	31,803	10,756	6,356	17,387	7,783	0	12,293	34,892	5,980
San Onofre 3	0	0	22,140	82,720	85,420	38,290	69,311	155,689	113,328	89,403	0	0
Scattergood 1	279,469	774,549	836,114	771,720	832,160	568,025	825,171	830,768	777,218	834,558	806,270	720,793
Scattergood 2	841,069	745,227	842,512	403,042	380,725	805,916	837,057	802,786	399,030	219,044	-6,282	264,884
Scattergood 3	3,170	34,132	40,217	31,380	34,178	44,541	44,906	54,104	47,255	28,964	35,253	49,205
South Bay 1	45,202	25,708	-297	22,663	16,146	-465	2,558	2,391	15,446	5,132	22,156	54,318
South Bay 2	27,636	4,381	3,197	5,730	4,021	-258	997	12,330	25,473	37,300	40,865	25,979
South Bay 3	43,305	35,230	23,916	23,017	31,637	27,186	37,367	41,560	60,968	56,775	-182	19,689
South Bay 4	56,735	6,774	-370	7,651	9,714	12,394	1,545	173	16,890	49,076	44,351	11,232

Source: QFER Filings

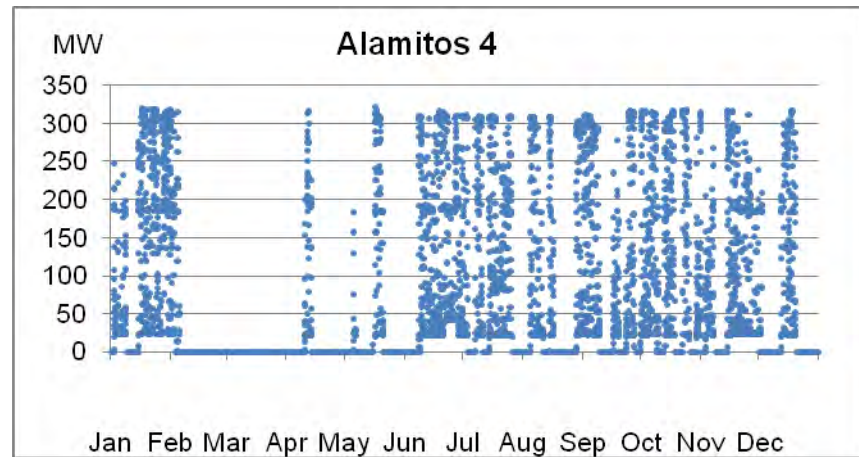
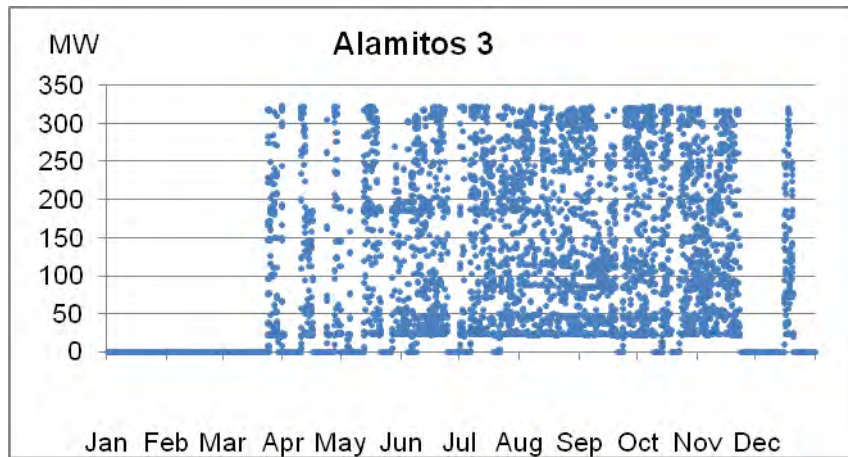
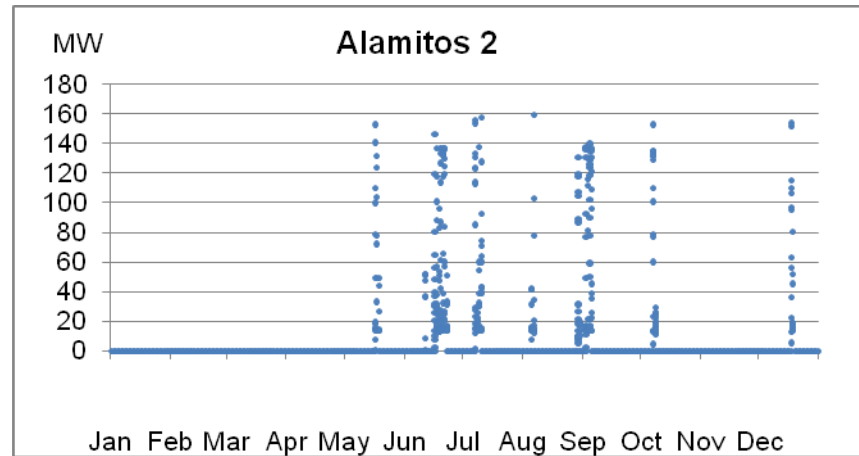
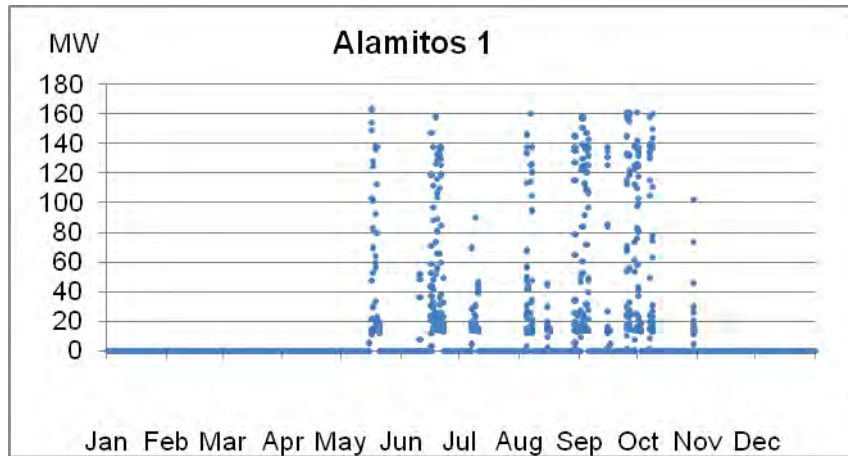
Table B-5: Aging and Once-Through-Cooled Power Plant Monthly Capacity Factors (2008)

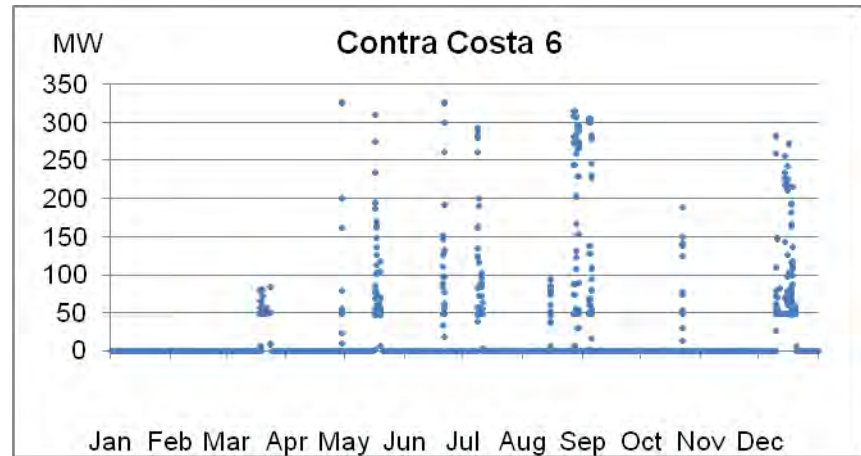
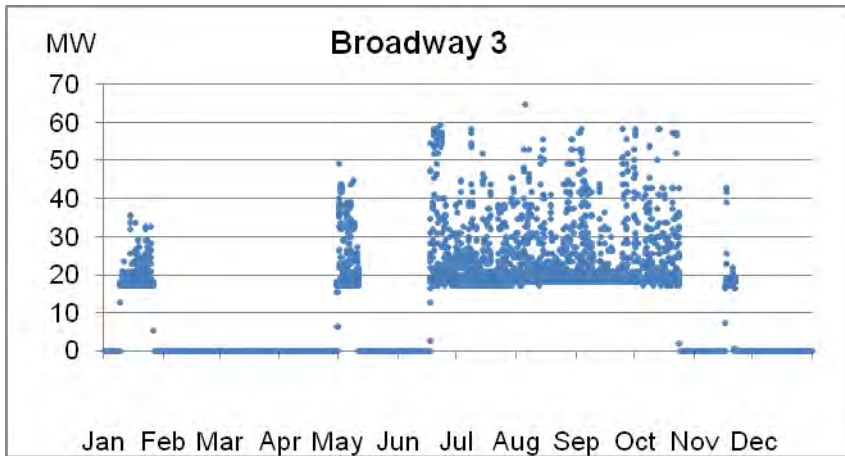
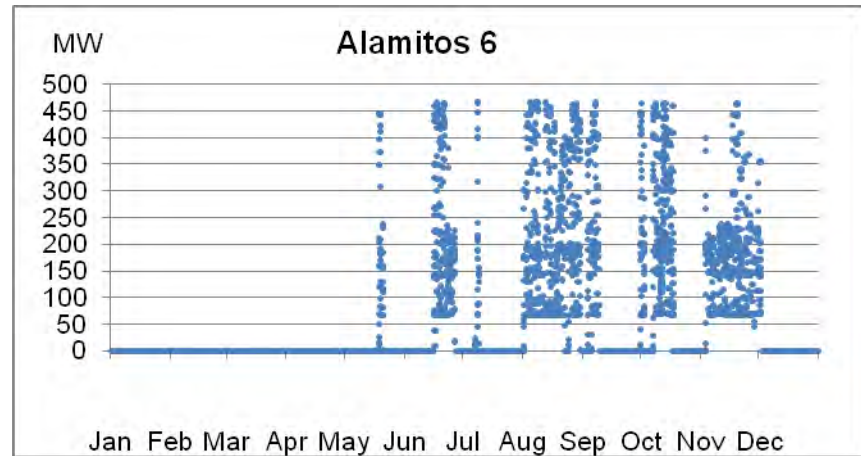
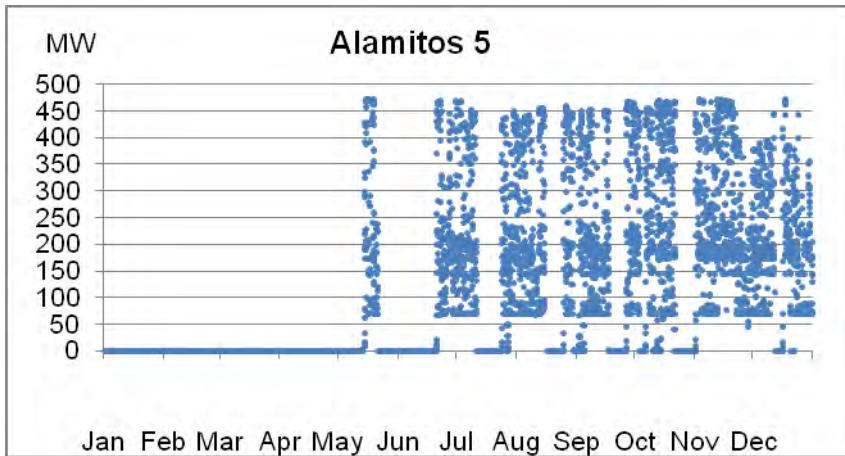
Power Plant / Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Alamitos 1	0	0	0	0	3	6	1	3	10	4	0	0
Alamitos 2	0	0	0	0	1	6	2	1	4	1	0	2
Alamitos 3	0	0	8	14	25	29	35	43	39	40	31	7
Alamitos 4	34	4	0	5	9	30	22	18	22	30	22	13
Alamitos 5	0	0	0	0	14	17	28	34	34	34	50	36
Alamitos 6	0	0	0	0	4	17	2	42	10	21	30	1
Broadway 3	15	0	0	0	12	18	30	31	30	23	4	0
Contra Costa 6	0	0	3	1	3	2	3	4	2	0	0	7
Contra Costa 7	0	0	0	1	4	0	6	14	5	2	0	9
Coolwater 1	0	0	0	0	4	0	0	0	0	0	0	0
Coolwater 2	0	0	0	0	4	0	0	3	0	0	0	0
Coolwater 3	14	6	0	0	0	6	3	19	14	22	21	4
Coolwater 4	7	8	1	16	5	8	5	23	22	33	23	8
Diablo Canyon 1	100	101	102	101	95	102	101	101	101	98	101	101
Diablo Canyon 2	100	5	0	56	102	101	101	50	80	89	100	101
El Centro 3	0	0	0	0	2	21	29	30	16	0	0	0
El Centro 4	22	18	0	34	33	13	33	40	38	33	36	36
El Segundo 3	0	0	1	3	7	7	13	1	2	0	0	0
El Segundo 4	7	6	1	2	8	13	21	22	23	59	4	5
Encina 1	0	0	0	1	0	0	1	0	0	5	0	3
Encina 2	0	0	0	0	0	0	1	0	7	7	10	17
Encina 3	23	0	0	2	7	0	1	1	5	9	6	26
Encina 4	0	10	0	10	1	17	11	23	27	11	5	16
Encina 5	17	3	4	26	15	22	14	24	34	35	28	28
Etiwanda 3	6	0	0	9	12	30	29	37	31	33	8	14
Etiwanda 4	0	0	0	1	10	16	18	25	22	18	15	13
Grayson 3	2	2	0	0	6	2	0	1	0	0	1	0
Grayson 4	6	24	35	34	14	27	24	10	26	0	19	10
Grayson 5	30	14	0	0	26	12	14	33	9	39	23	28
Grayson CC	2	1	1	1	1	0	4	6	6	1	5	1
Harbor CC	2	8	0	8	11	13	7	12	8	4	14	8
Haynes 1	10	42	29	25	20	33	0	30	3	12	39	37
Haynes 2	34	0	0	38	6	18	35	26	35	18	15	10
Haynes 5	0	0	20	25	5	7	27	22	51	14	16	47
Haynes 6	0	0	0	0	-1	-1	16	28	0	0	0	0
Haynes Unit CC	88	88	75	86	81	71	83	84	79	68	33	0

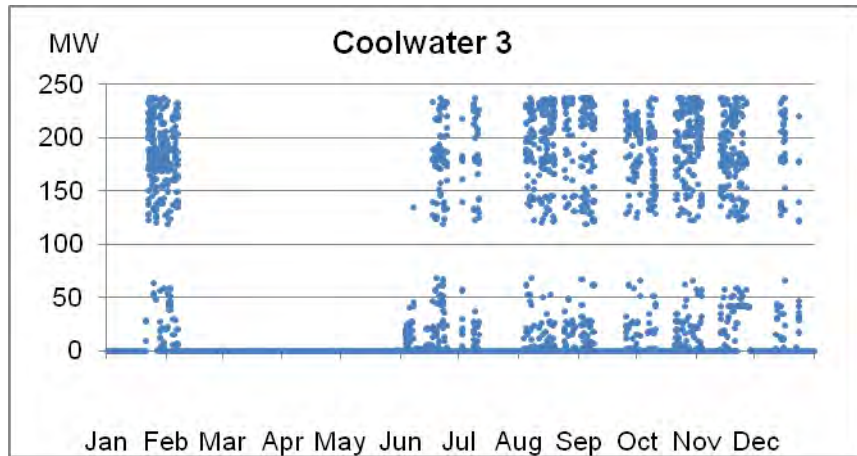
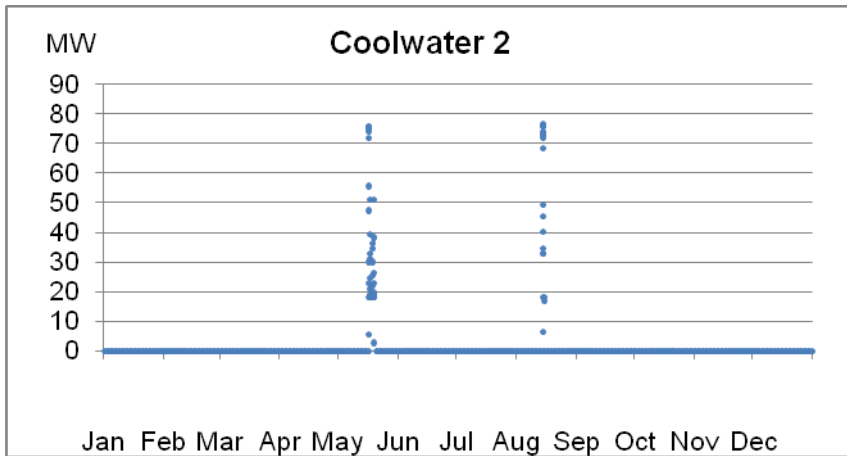
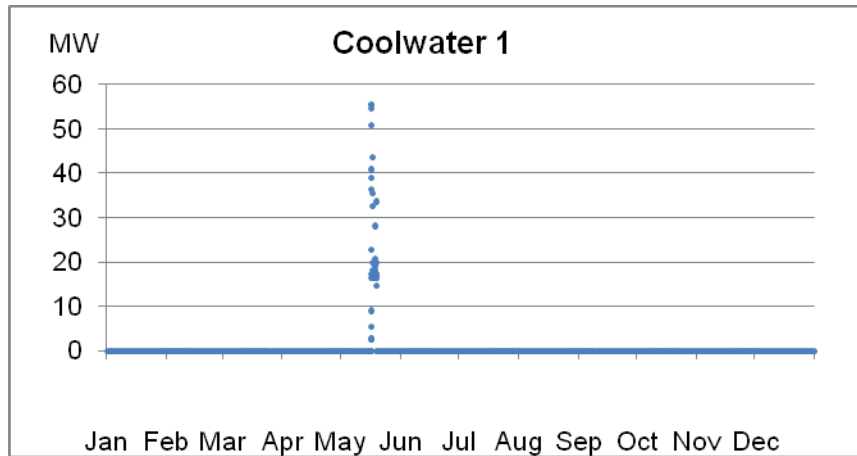
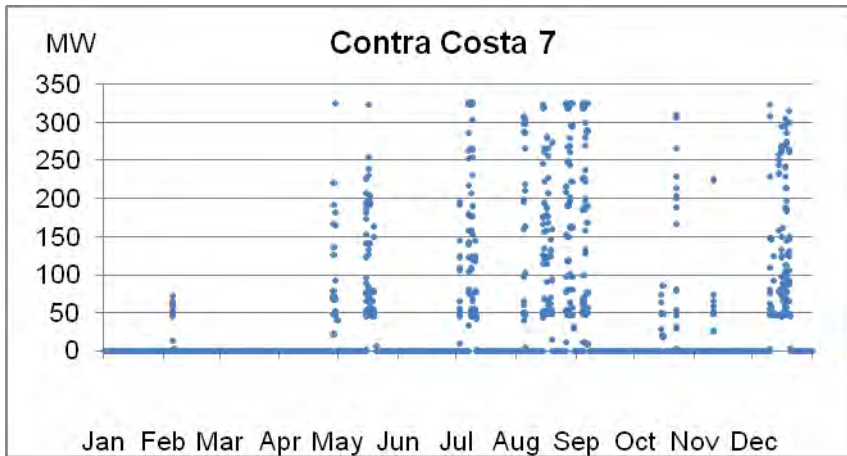
Power Plant / Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Humboldt Bay 1	66	66	47	22	58	55	56	49	70	52	65	50
Humboldt Bay 2	63	68	75	76	53	52	42	43	13	49	40	65
Huntington Beach 1	41	26	21	20	26	34	31	39	38	43	2	17
Huntington Beach 2	36	21	10	1	8	36	26	34	15	32	9	14
Huntington Beach 3	11	0	0	44	8	5	18	33	29	17	34	4
Huntington Beach 4	0	0	0	2	23	21	27	7	33	37	19	5
Mandalay 1	9	0	1	0	4	12	14	21	21	30	24	7
Mandalay 2	19	7	6	19	11	16	23	31	24	35	29	10
Morro Bay 3	3	0	0	0	0	2	4	3	1	1	0	0
Morro Bay 4	3	0	0	0	0	4	3	13	0	0	0	0
Moss Landing 6	8	10	7	12	10	0	6	26	9	8	8	9
Moss Landing 7	15	13	0	7	10	8	32	35	17	3	1	14
Moss Landing 1	83	79	68	49	49	47	68	76	65	58	57	70
Moss Landing 2	43	51	72	76	29	50	61	73	64	55	52	71
Olive 1	0	0	0	3	0	0	0	4	0	0	14	0
Olive 2	0	0	0	0	0	0	6	0	0	0	2	0
Ormond Beach 1	3	0	4	3	0	5	4	12	8	2	5	1
Ormond Beach 2	0	0	2	5	3	8	10	26	11	9	3	7
Pittsburg 5	0	0	0	0	5	0	6	0	0	0	0	0
Pittsburg 6	0	0	3	1	8	0	7	4	4	0	0	0
Pittsburg 7	0	0	4	1	3	2	6	4	3	1	0	3
Potrero Power 3	30	34	8	0	22	28	32	39	39	38	38	42
Redondo Beach 5	0	0	1	0	3	0	6	0	7	6	0	0
Redondo Beach 6	0	0	0	0	0	2	2	2	4	1	0	0
Redondo Beach 7	0	0	1	0	1	4	3	5	5	0	0	0
Redondo Beach 8	0	0	0	0	9	0	0	5	0	0	39	0
San Onofre 2	33	99	100	96	100	70	99	100	96	100	100	86
San Onofre 3	100	95	100	50	46	100	100	96	49	26	0	32
Scattergood 1	41	14	19	25	8	5	13	6	0	9	27	4
Scattergood 2	0	0	7	26	26	12	21	47	35	27	0	0
Scattergood 3	2	27	30	24	26	35	34	41	37	22	27	37
South Bay 1	45	27	0	23	16	0	3	2	16	5	23	54
South Bay 2	27	5	3	6	4	0	1	12	26	37	42	26
South Bay 3	28	24	15	15	20	18	24	27	40	36	0	13
South Bay 4	36	5	0	5	6	8	1	0	11	31	29	7

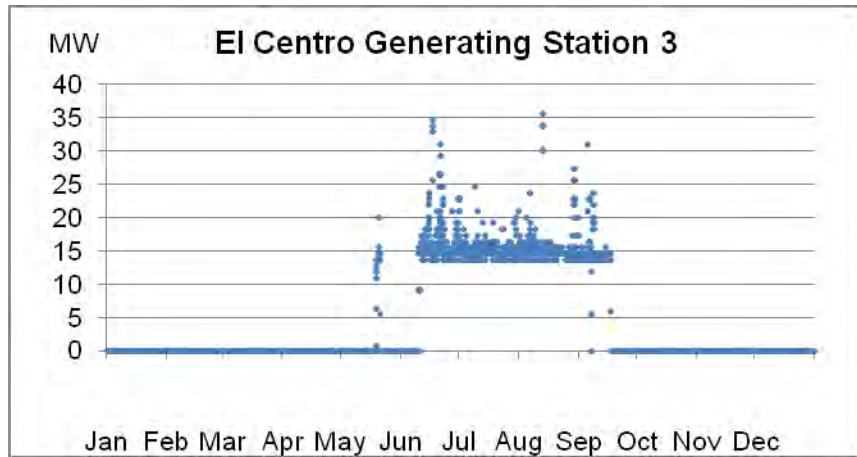
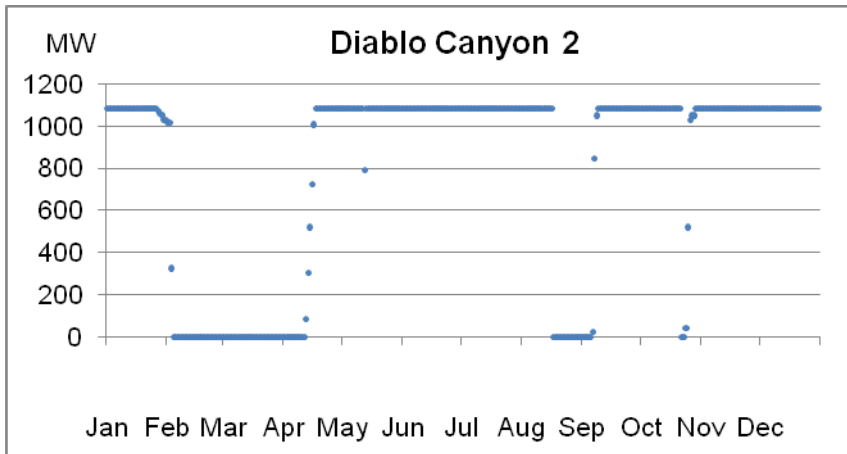
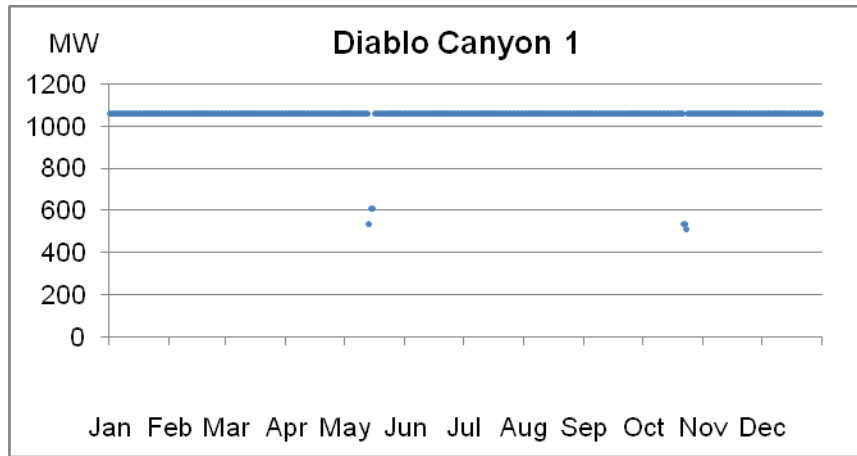
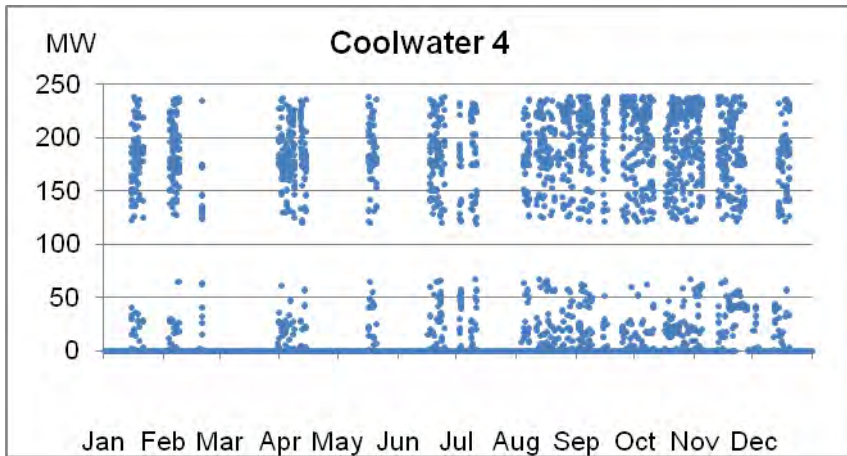
Source: QFER Filings

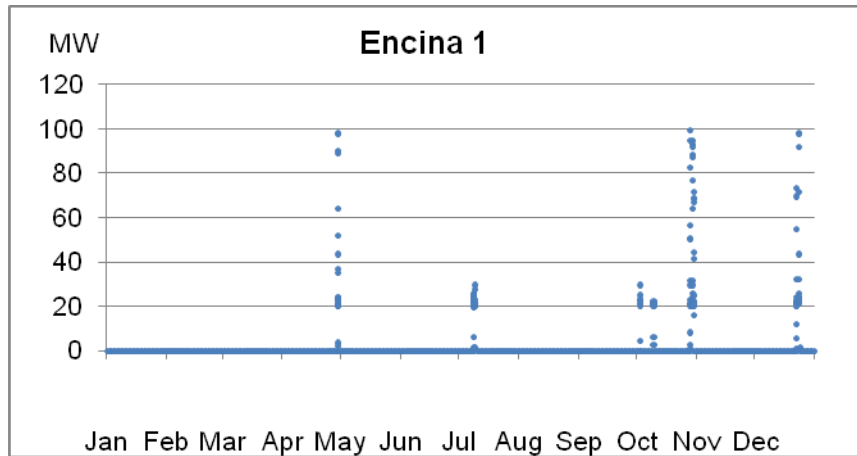
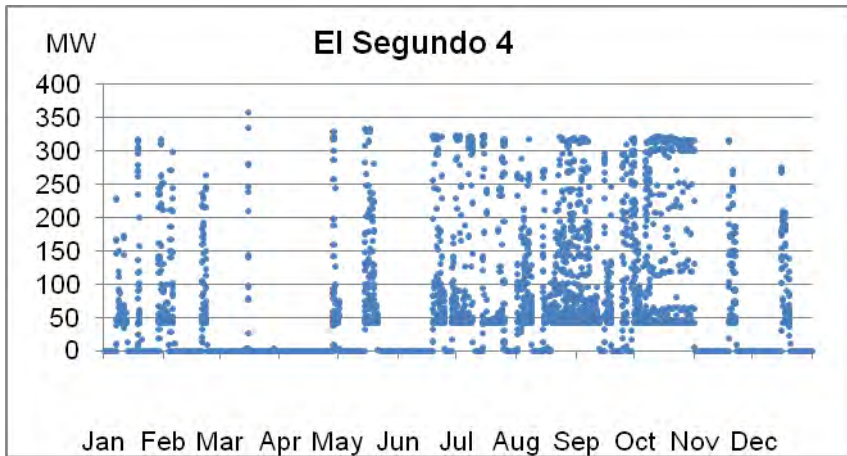
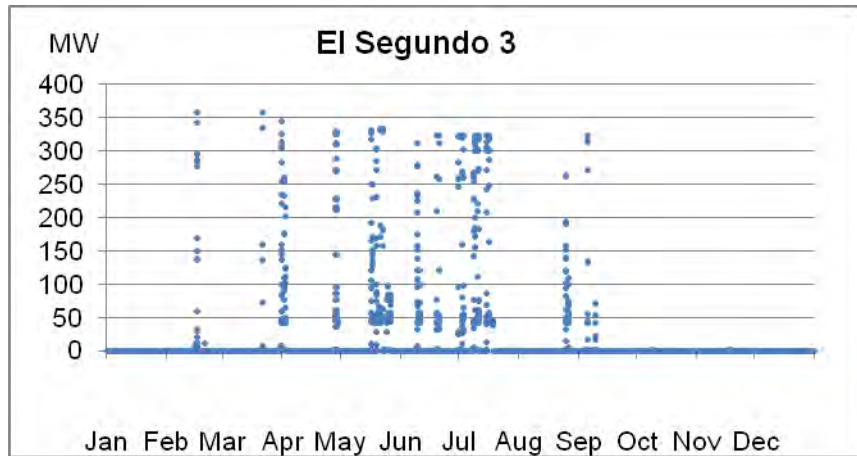
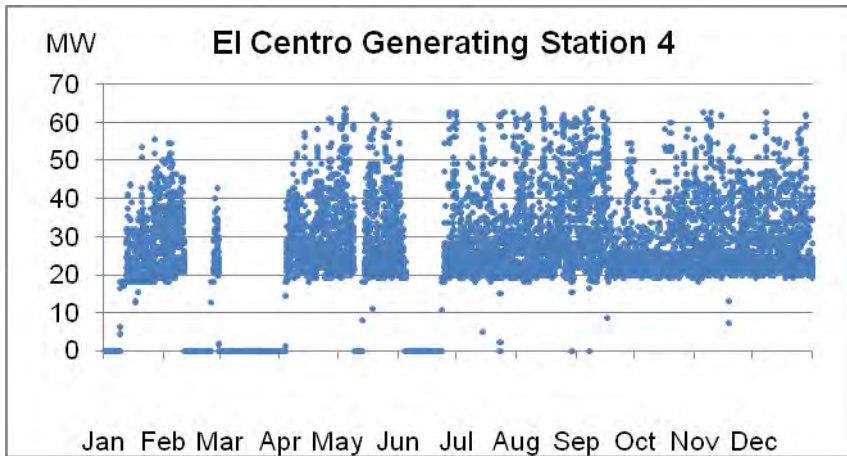
Figure B-1: Individual Unit Hourly Operations (2008)

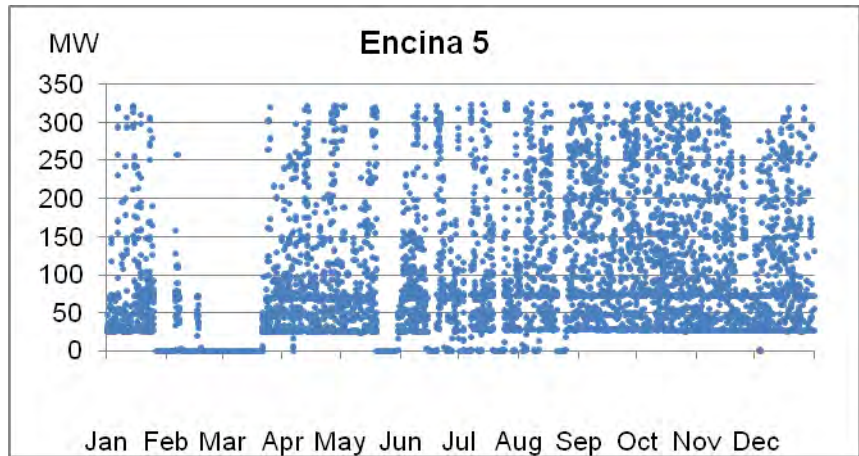
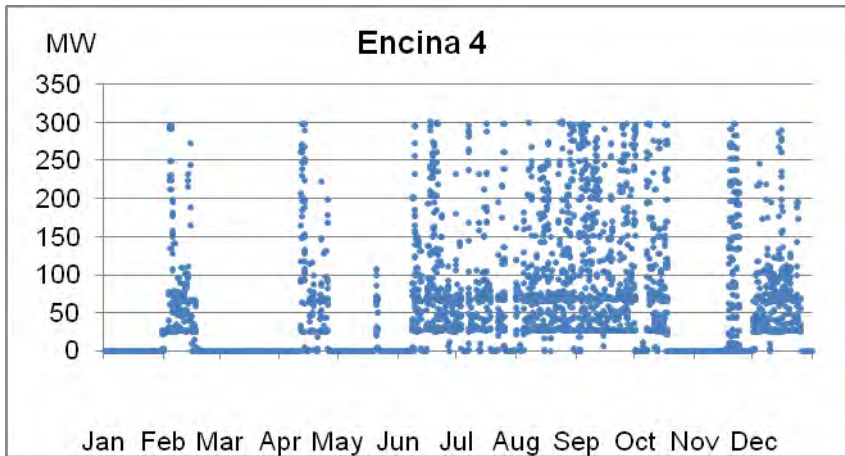
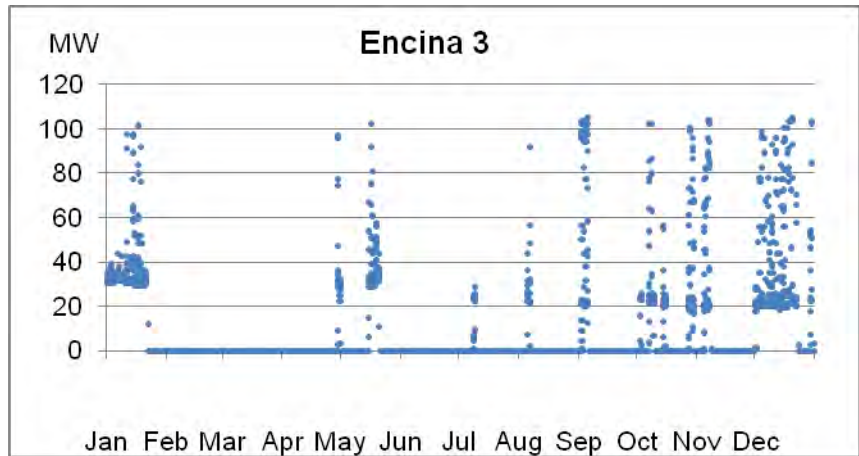
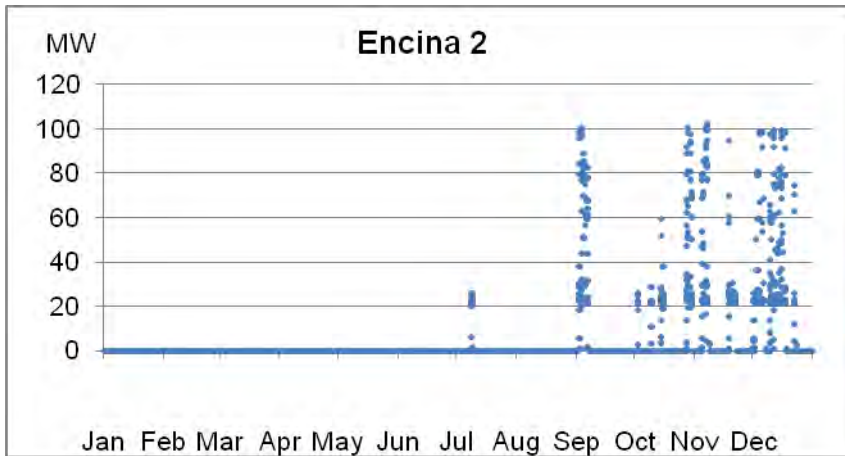


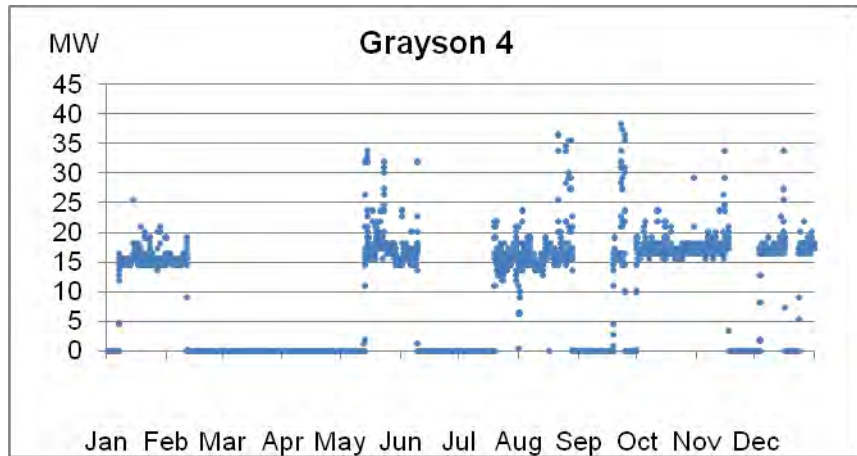
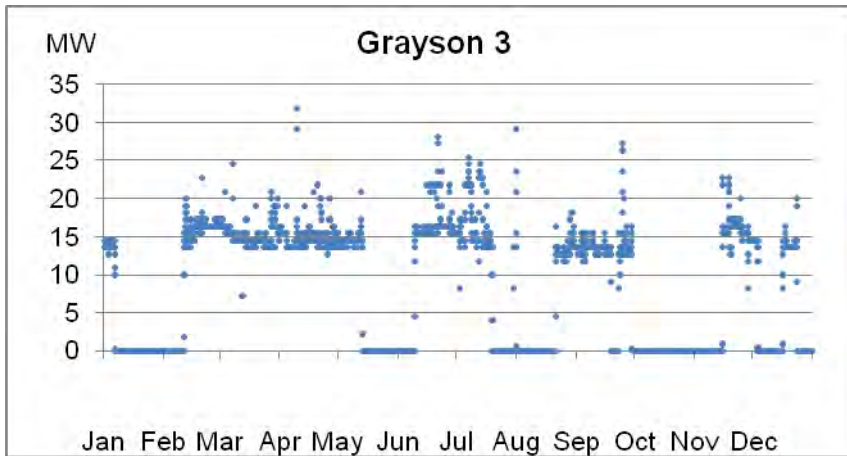
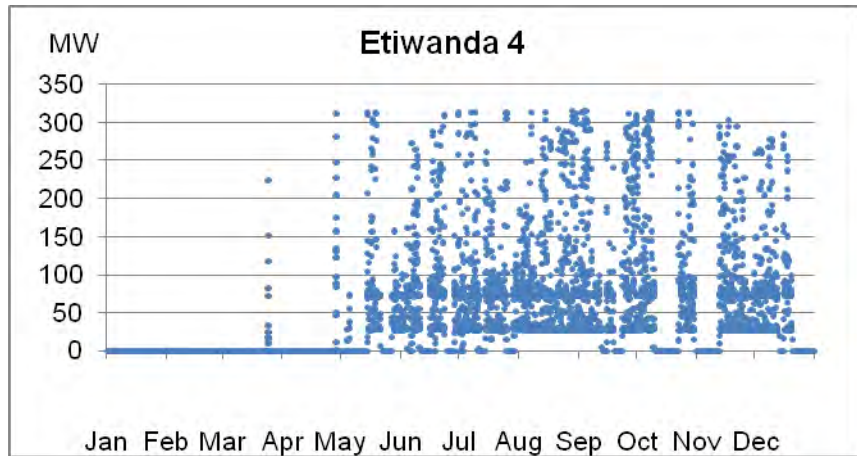
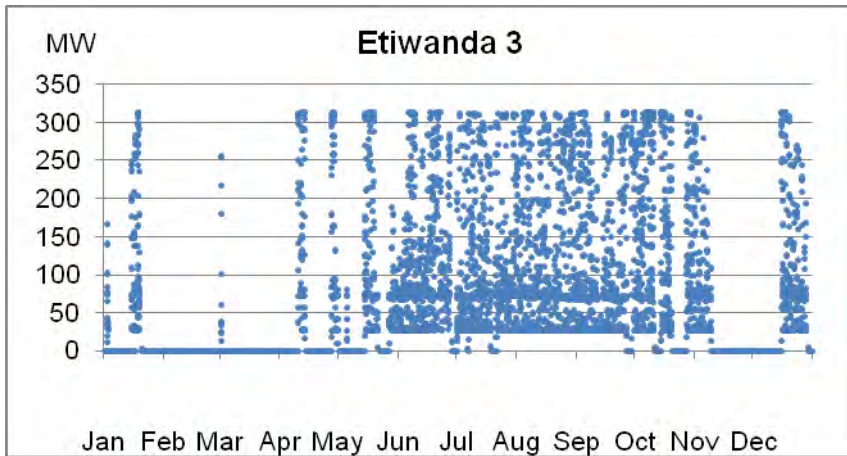


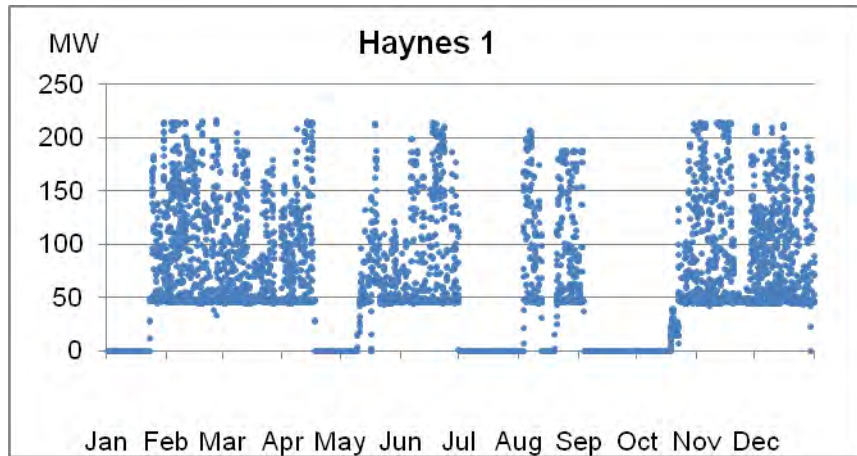
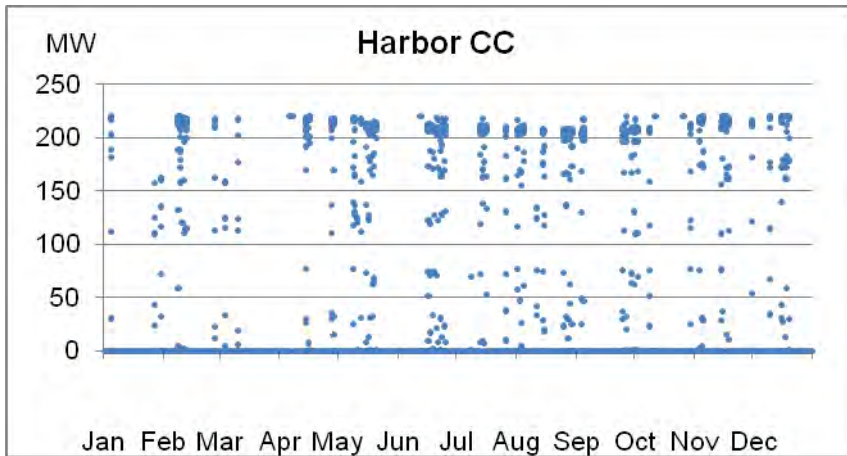
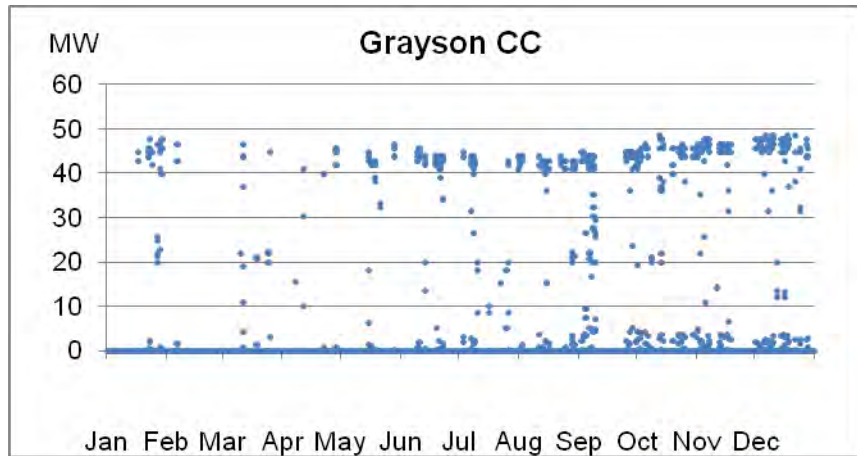
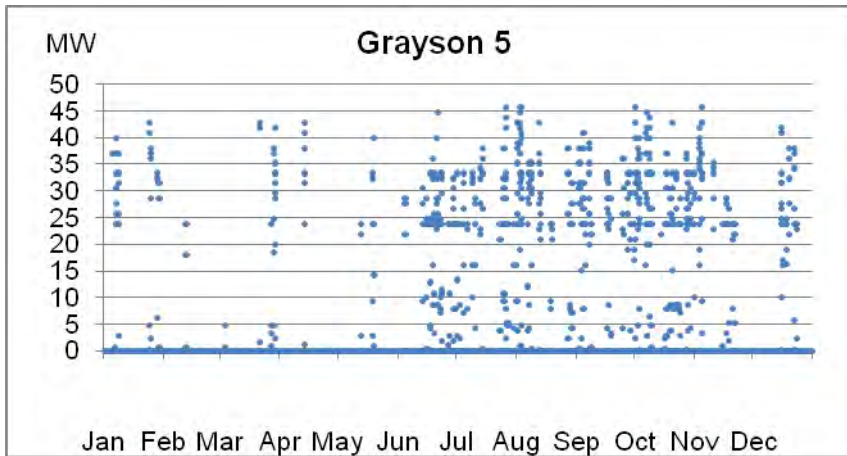


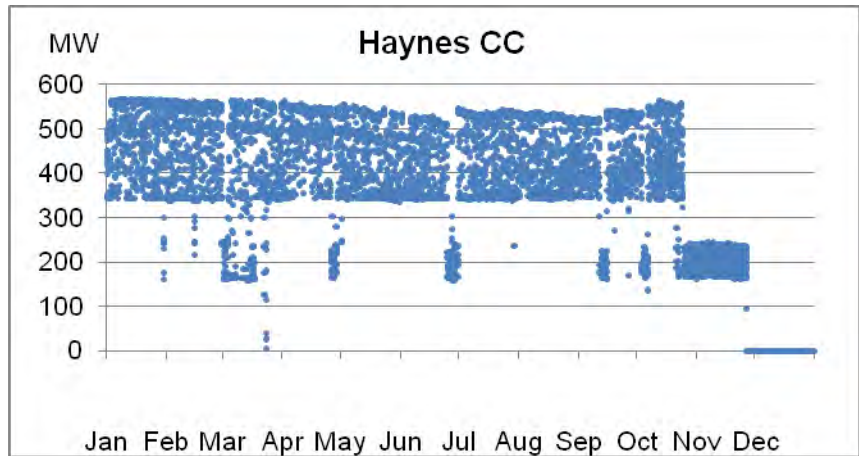
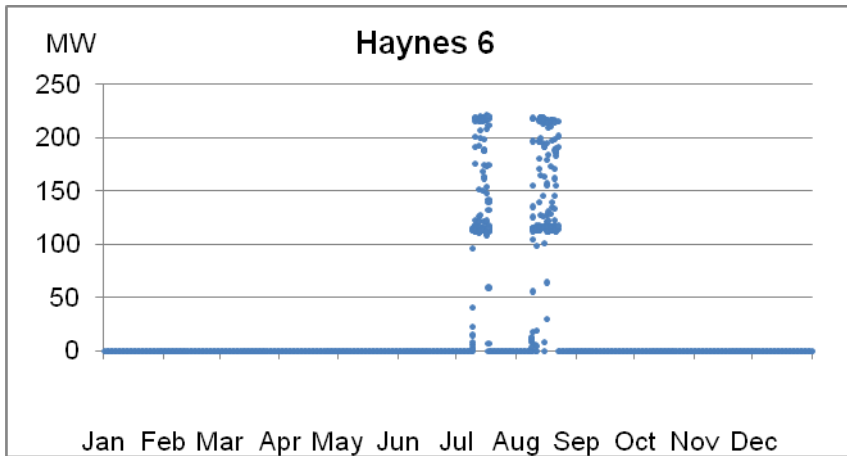
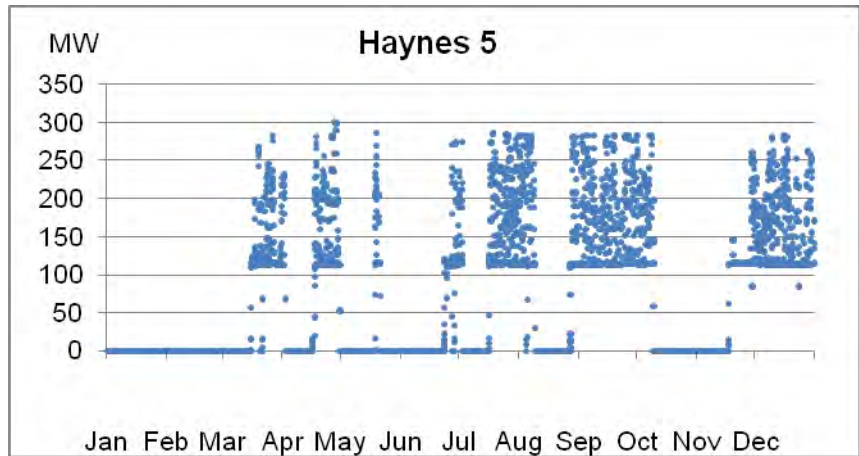
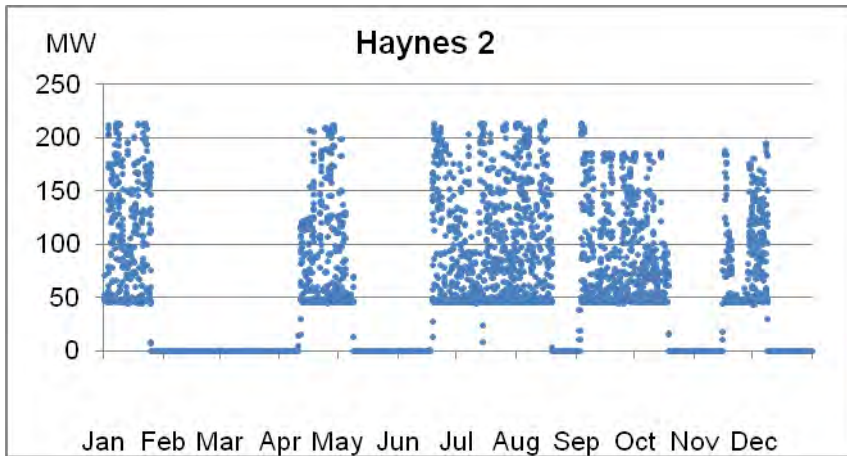


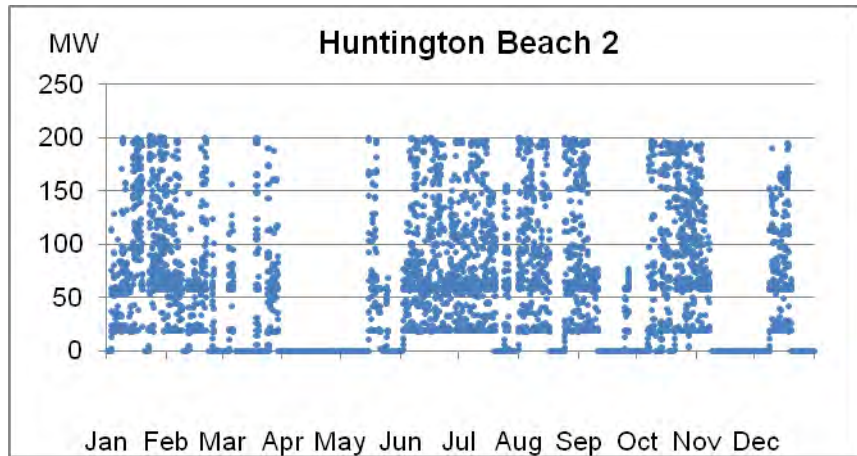
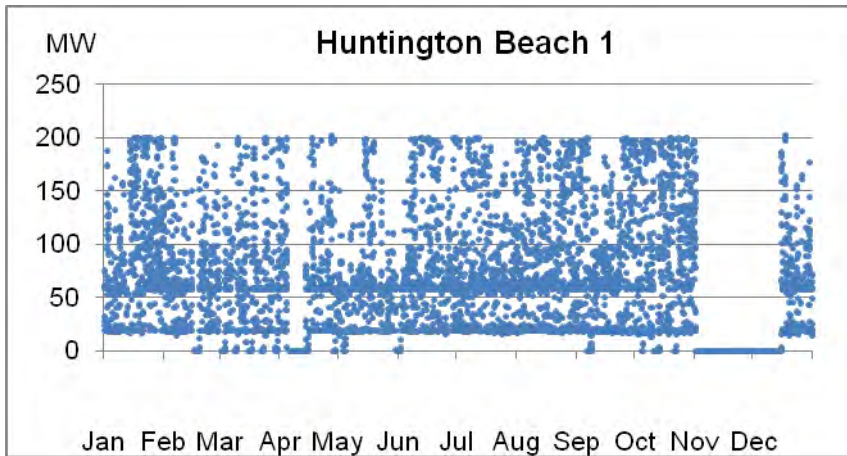
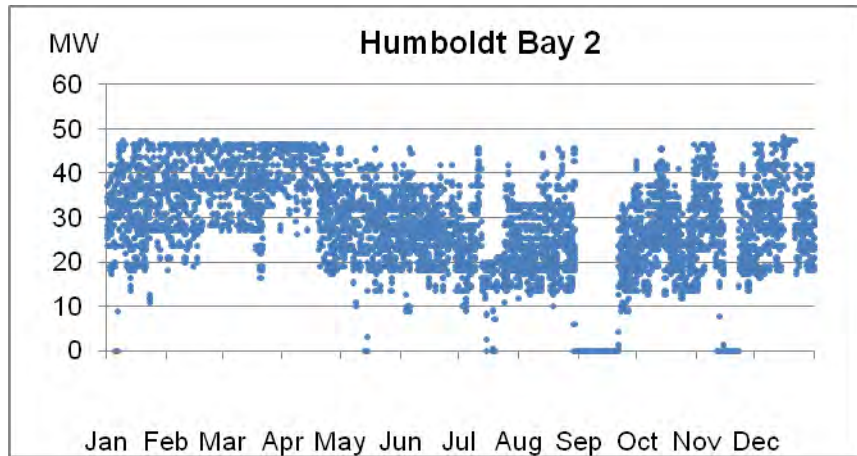
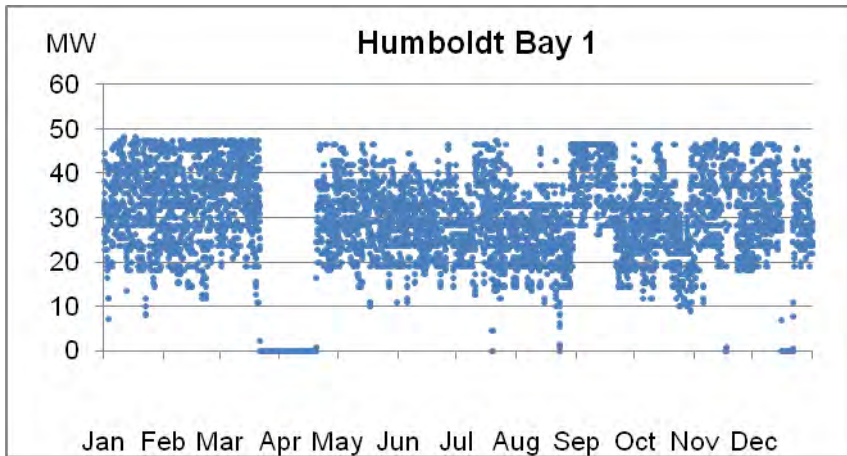


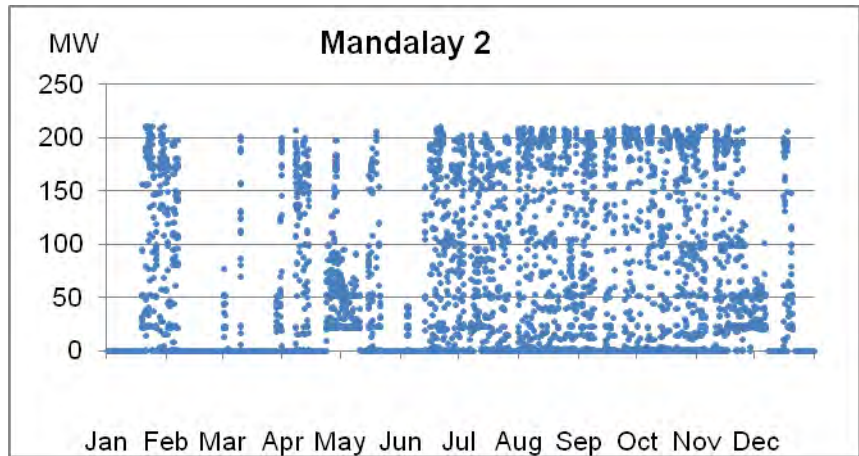
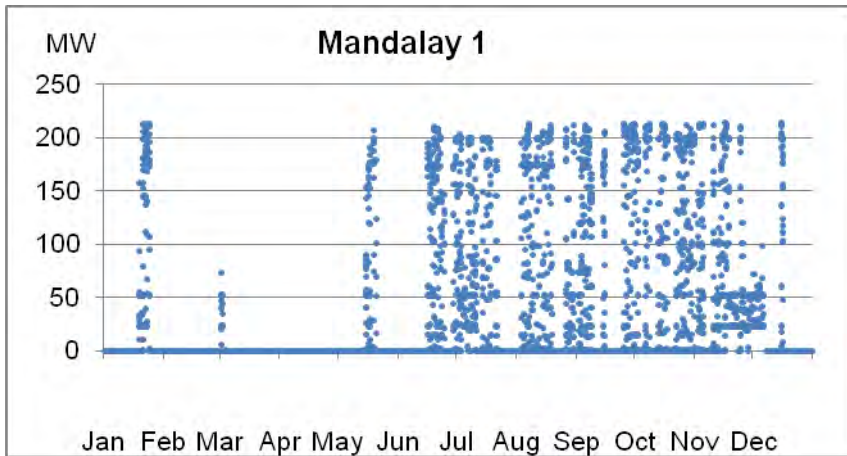
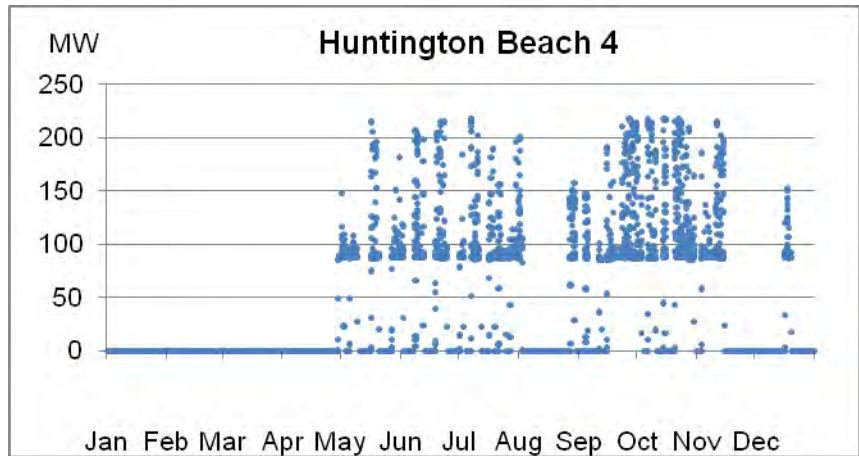
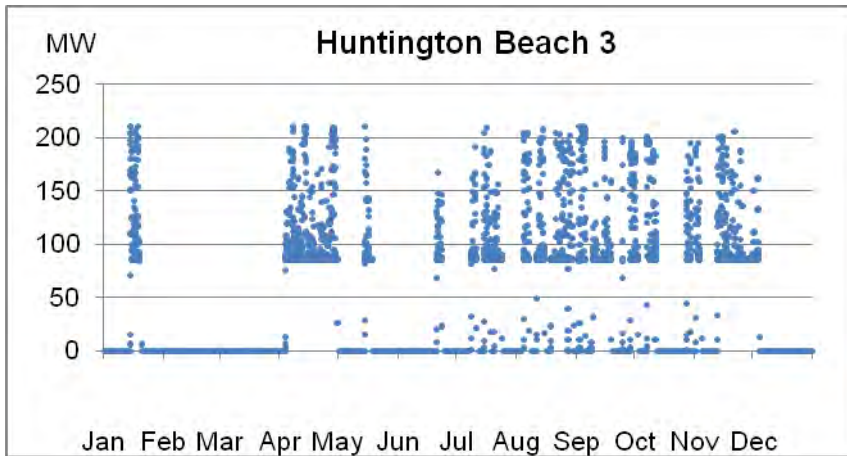


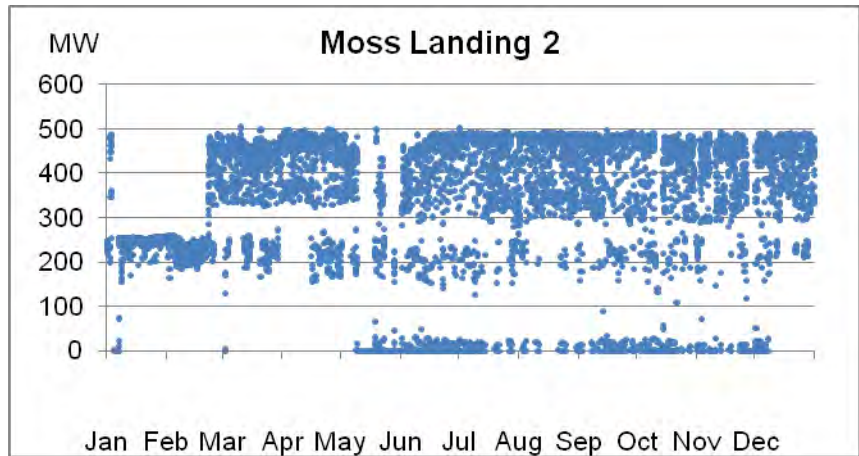
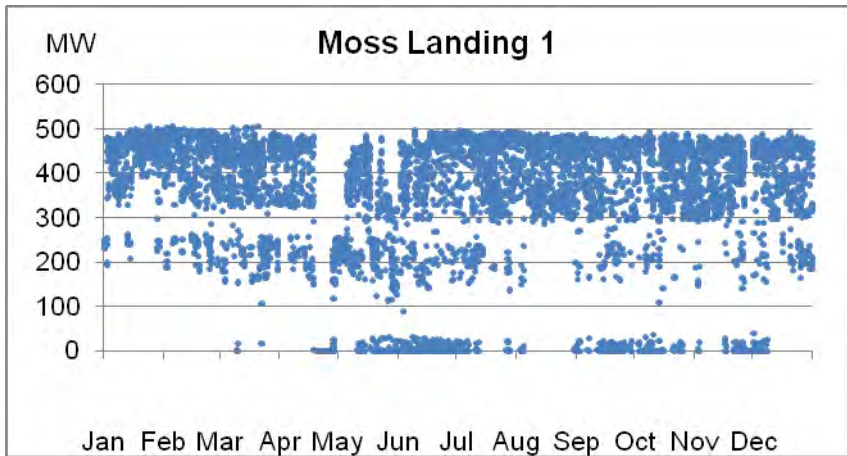
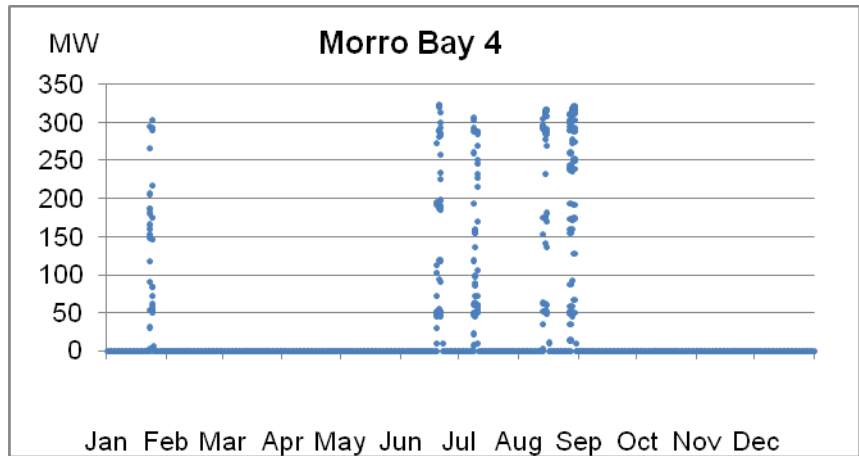
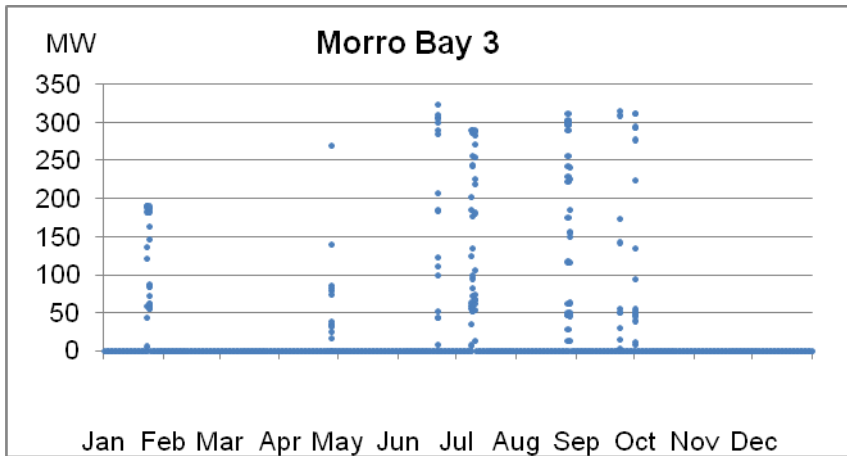


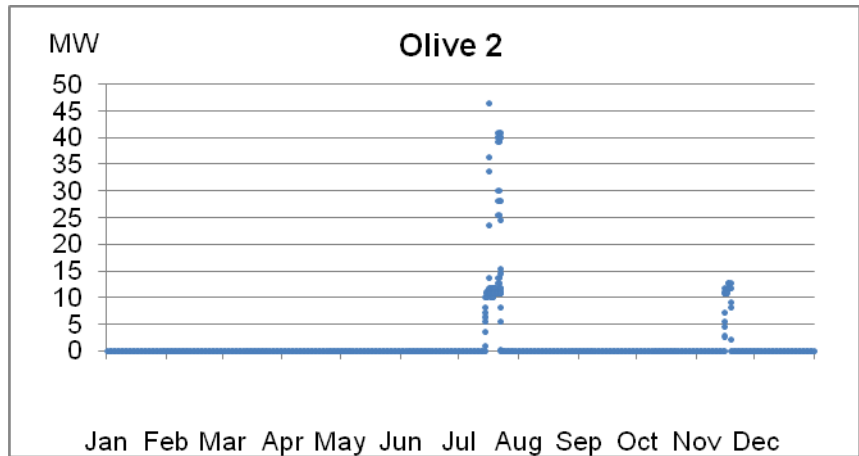
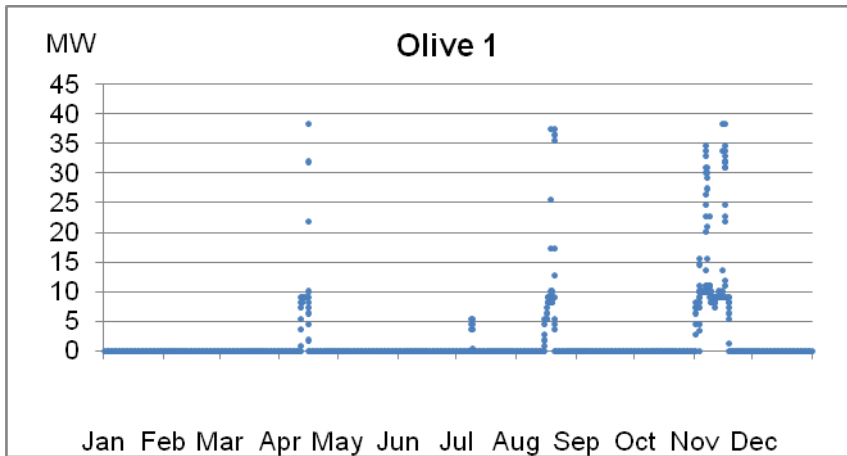
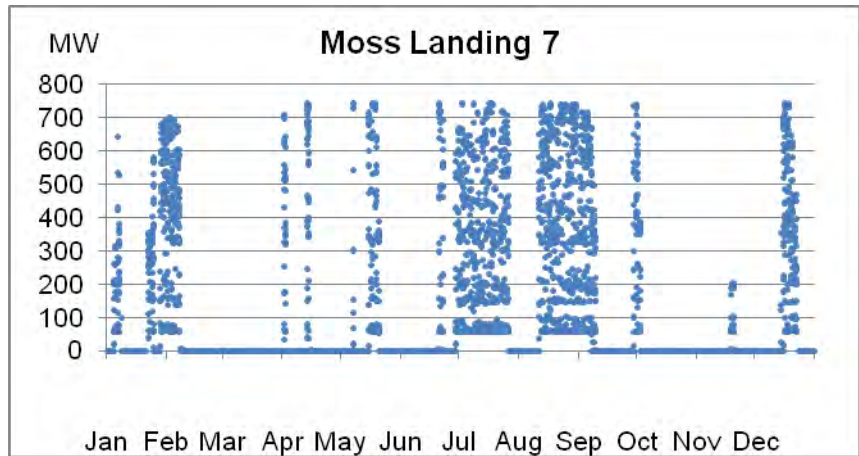
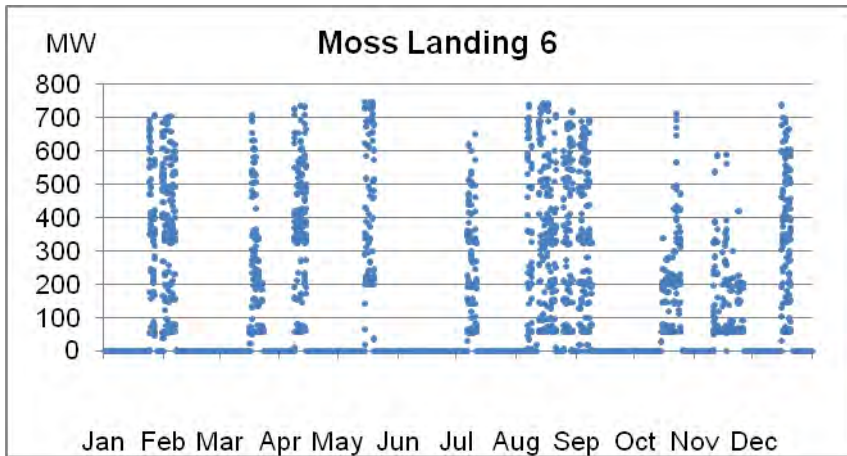


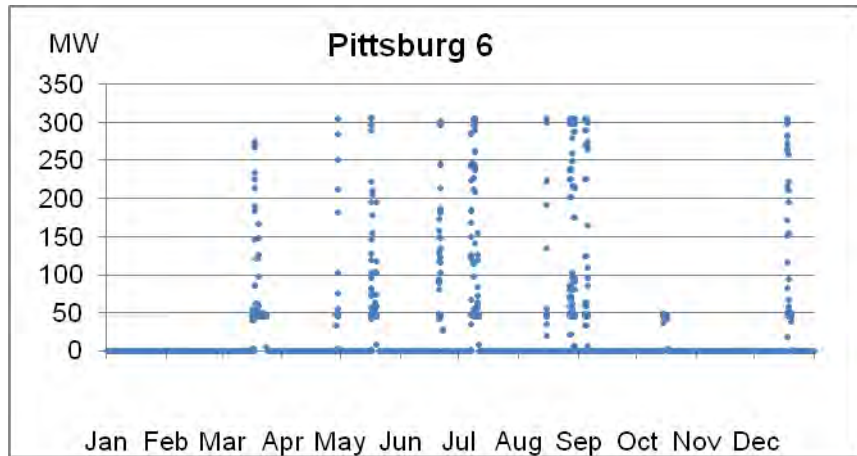
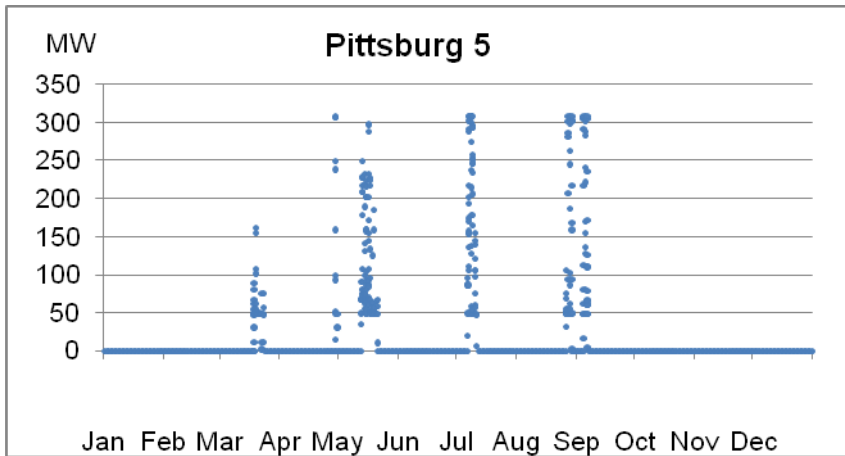
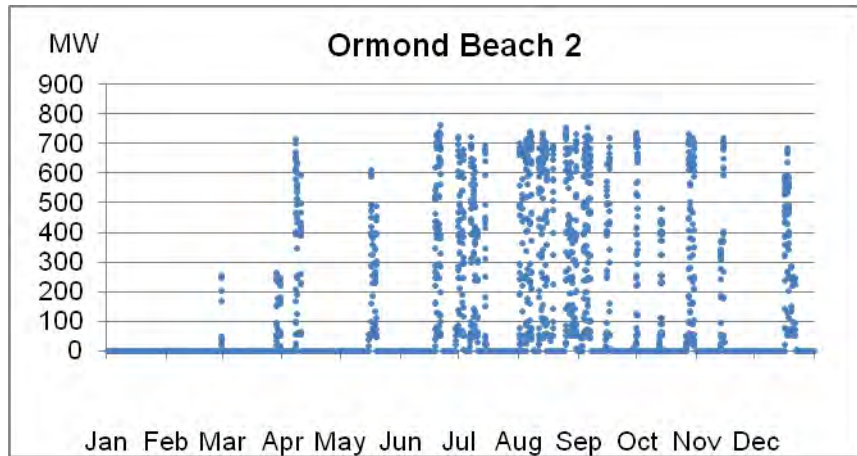
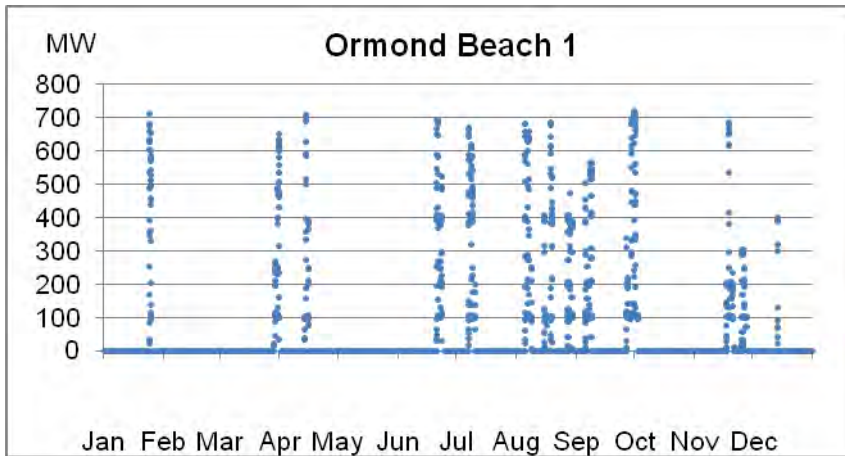


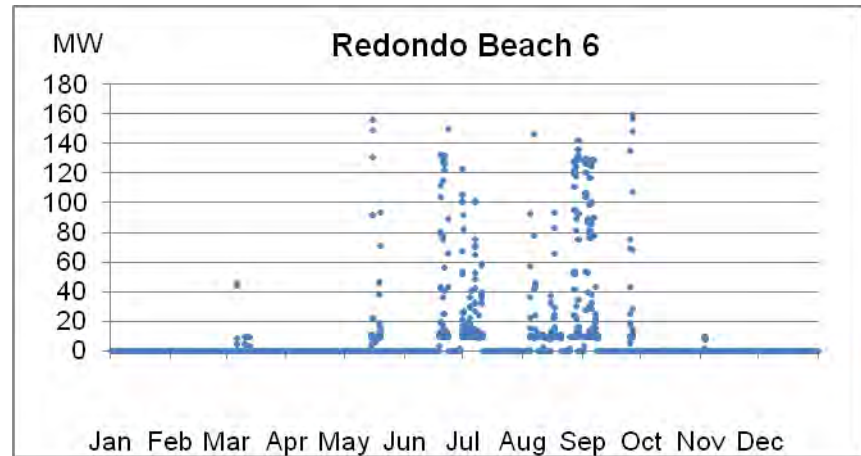
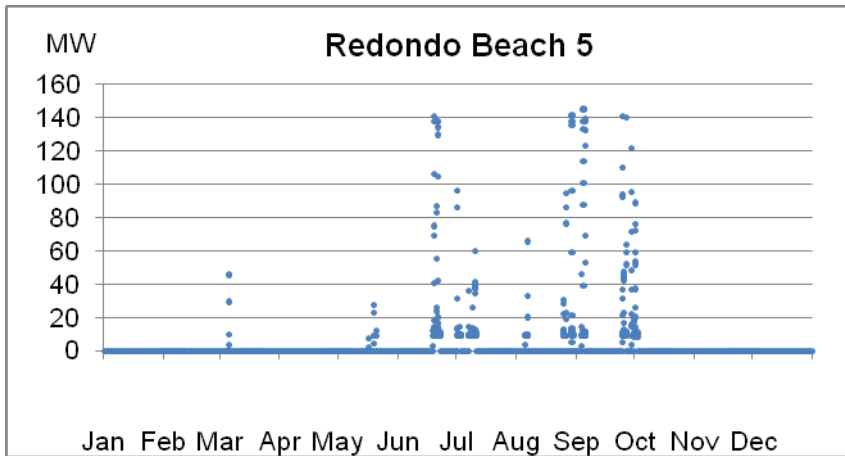
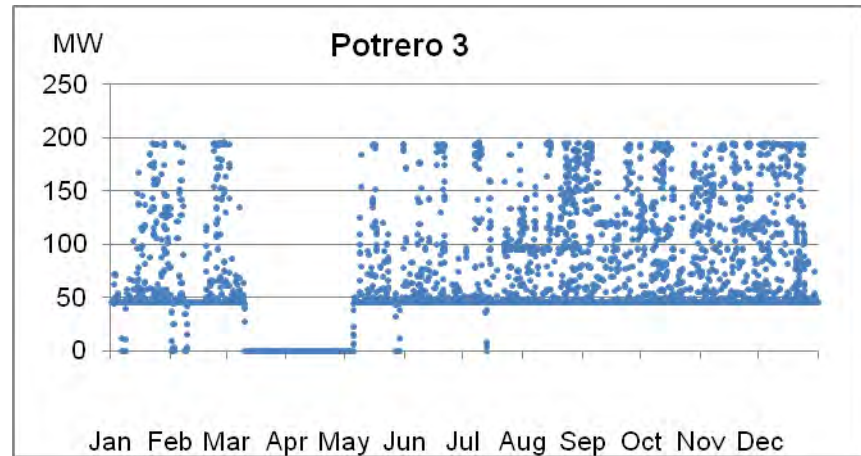
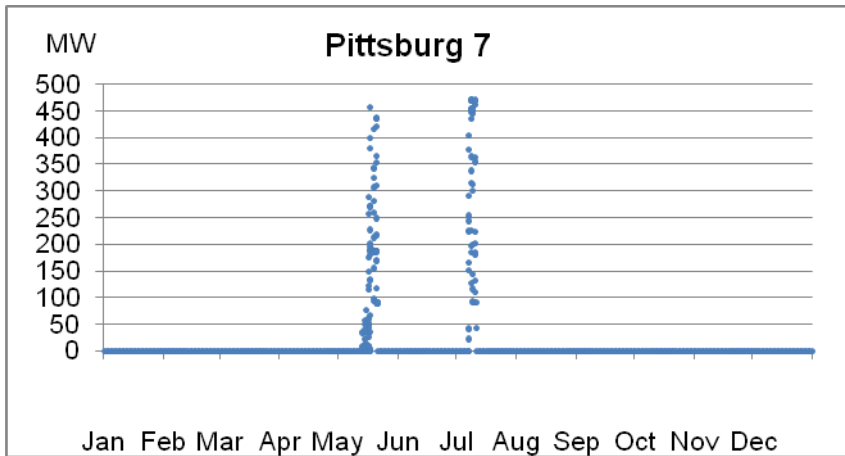


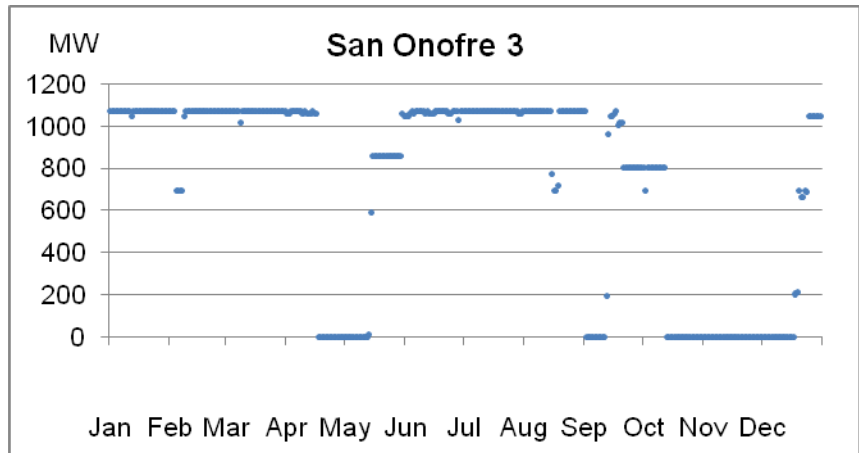
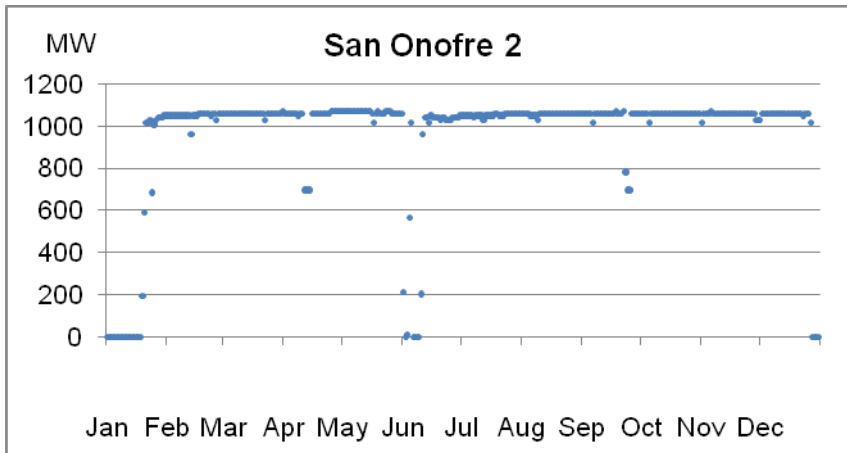
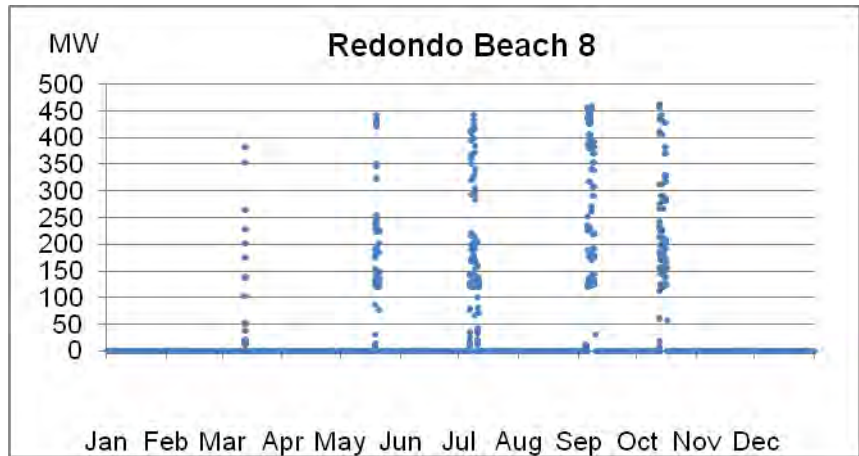
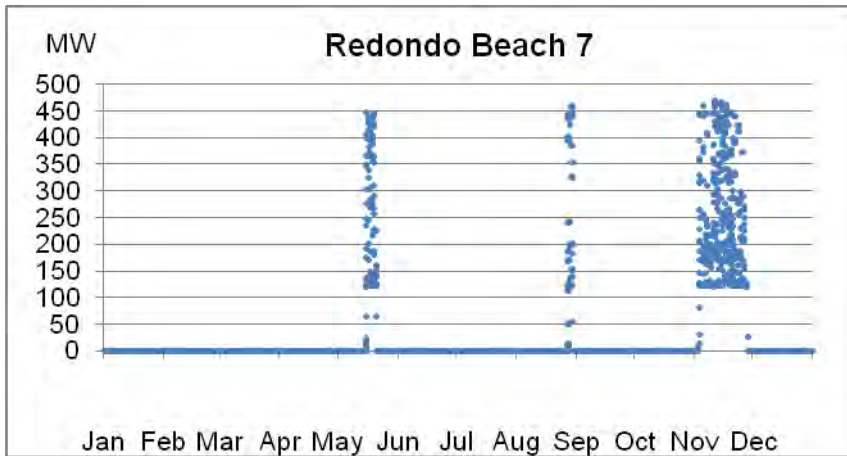


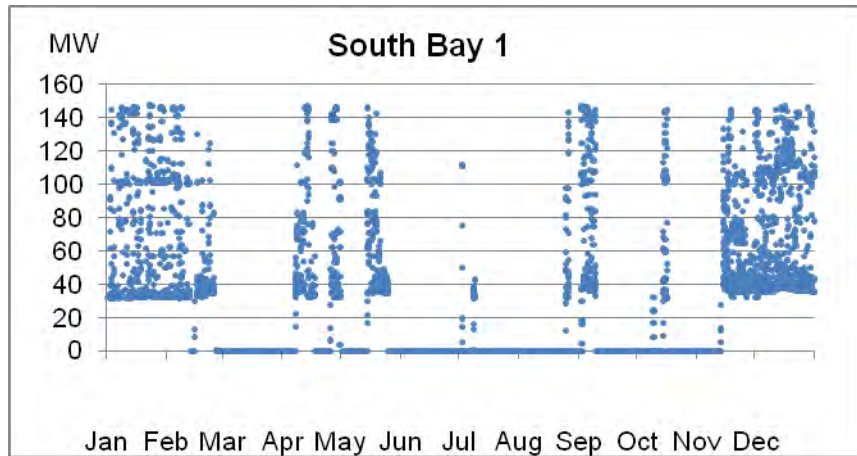
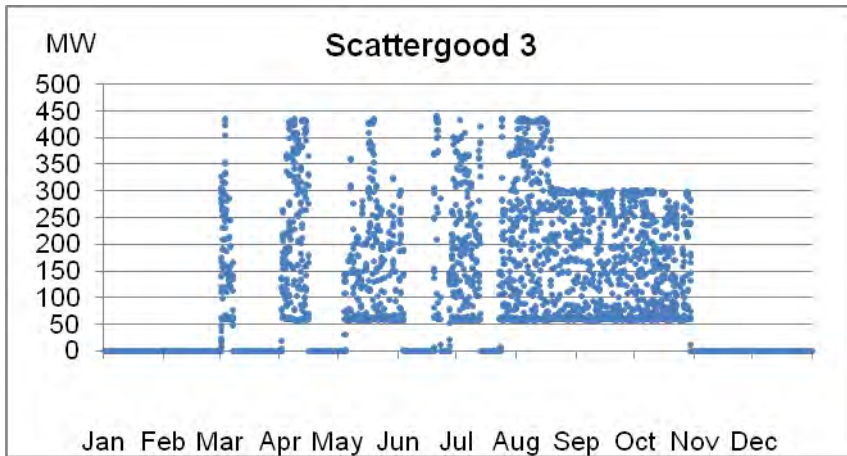
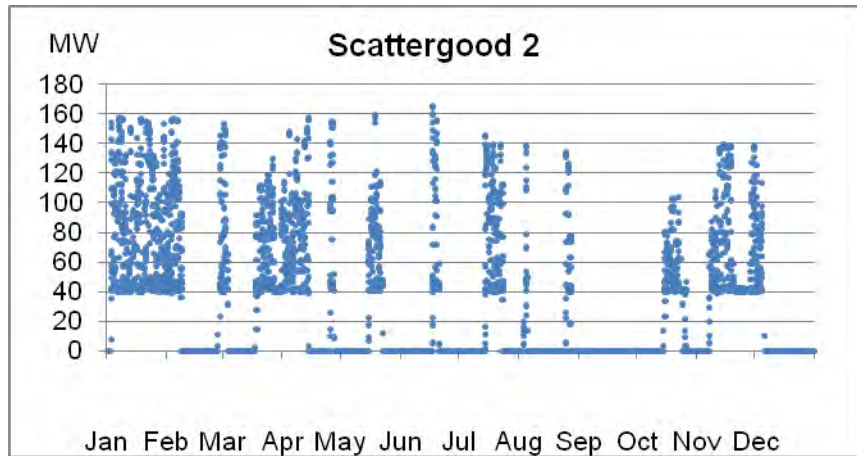
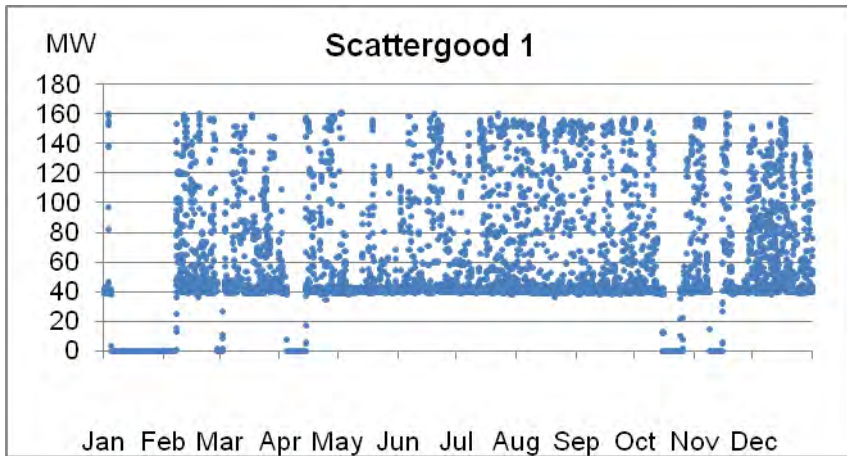


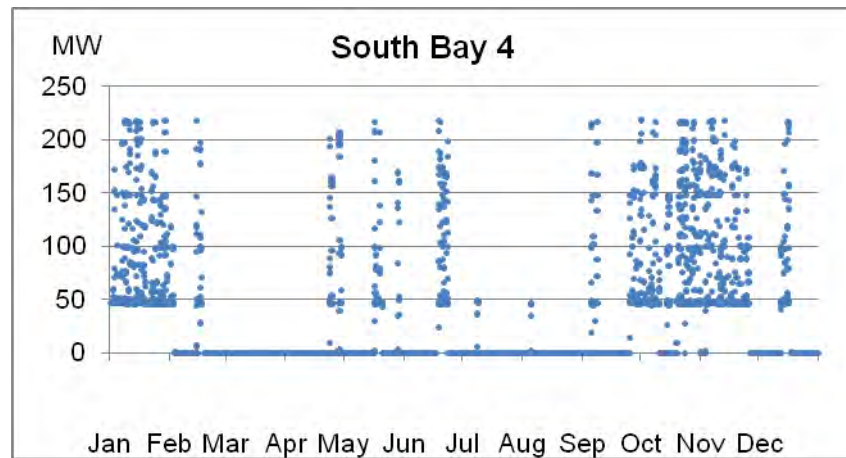
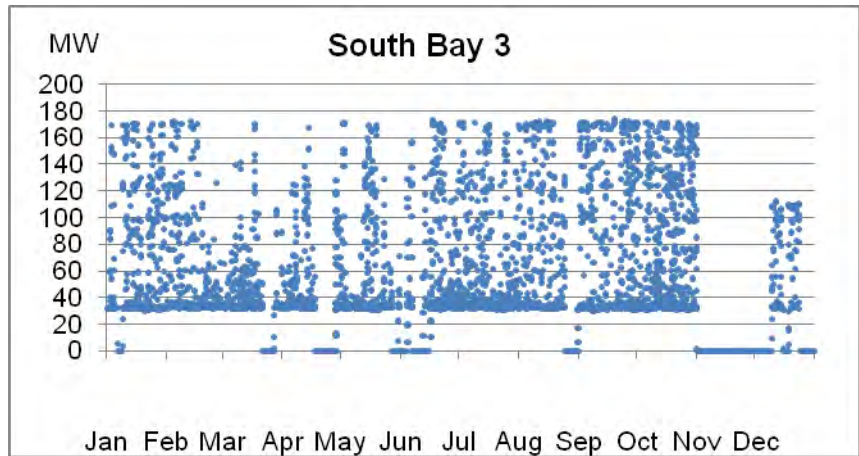
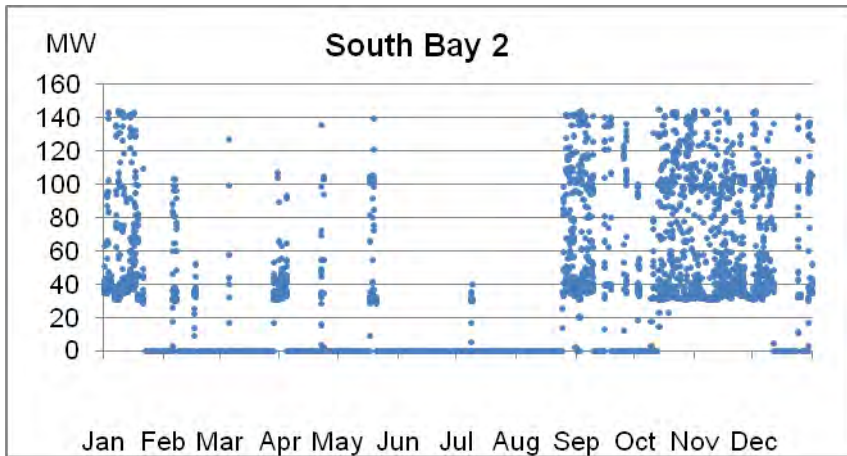












Source: EPA Continuous Emissions Monitoring Survey data.